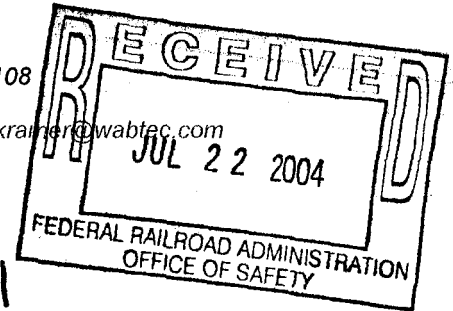


293112



Mark Kramer  
504 Peonies Terrace  
Rockville, MD 20850

Phone: 301-762-0108  
Fax: 301-762-0109  
E-Mail Address: mkramer@wabtec.com



July 21, 2004

FRA-2004-18895-1

Federal Railroad Administration  
TrainLink II – Annual Inspection / Test for Head End Device  
Request for Waiver - 49 CFR 232.409 (d)

Mr. Grady Cothen  
Deputy Associate Administrator  
For Safety Standards & Program Development  
Federal Railroad Administration  
400 7<sup>th</sup> Street, S.W.  
M/S 25  
Washington D.C. 20590

DEPT. OF TRANSPORTATION  
OFFICE OF SAFETY  
JUL 22 2004

Dear Mr. Cothen;

In accordance with our recent meeting held at FRA offices, and per your recommendation, please accept this letter as our official Request for Waiver to 49 CFR 232.409 (d) annual inspection and calibration of telemetry equipment.

The waiver would cover all Wabtec TrainLink II Head of Train (HTD's) and End of Train devices (EOT's) that were produced since March 4, 2002, and all existing TrainLink units that have been upgraded with the new WRE digitally synthesized radio. It should preclude the annual requirements for the testing, calibration, inspection and record keeping requirements covered in 49CFR 232.409 (d).

Wabtec and associated service centers will attach a sticker on all new and upgraded units identifying they are equipped with the new WRE digital radio and are covered by the waiver, if approved.

The basis of our request is due to the advanced technology of the new digital radio being provided in today's new and upgraded equipment. Previous generation radio designs used manual tuning coils and potentiometers that were subject to drift due to vibration and temperature shifts. These older designs required manual adjustments to assure that the radio was operating on the proper frequencies.

The new WRE TrainLink II synthesized digital radio provides a continuous, fully automatic self-calibrating feature, along with advanced diagnostics to assure accuracy and dependability in radio transmission. As a result, there is no manual calibration or adjustment in this new radio design.

The transceiver is designed specifically for the harsh railroad environment and incorporates phase lock loop (PLL) circuitry, along with temperature and voltage controlled crystal oscillators to maintain spectral (signal) purity. This automatic calibration algorithm works by optimizing the VCO



**Wabtec**  
CORPORATION

Mark Kramer  
504 Peonies Terrace  
Rockville, MD 20850

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control parameters to achieve minimum phase noise. It auto calibrates the power amplifier (PA) and power amplifier driver (RF) bias current every time the transmitter is powered. This automatic calibration feature is the heart of maintaining the radio's performance integrity.

Should the radio experience a component failure, the auto-cal routine will cycle continuously, effectively shut down the radio, and provide the appropriate "No Comm" display in the cab of the locomotive. Failure in the micro/power supply areas will also result in an inoperable radio, and the same "No Comm" message will be received in the locomotive cab.

**There is no need to annually test and calibrate the new synthesized radio essentially, if the radio is transmitting, "the signal is within specifications".**

The record keeping requirements of 232.409 (d) require the date and location of the last test or calibration, along with the name of the person performing the test or calibration be recorded on weather resistant sticker or on the FRA 49-A form. Since the synthesized radio requires no manual adjustments, there is no need for this information to be provided. It should preclude the annual requirements for the testing, calibration, inspection and record keeping requirements covered in 49CFR 232.409 (d).

The new radio also maintains an on-board operation log file. Data elements that trace the operational history of the radio are recorded electronically and are available for downloading if there is a question concerning radio operation. A list of the data elements that are recorded by the radio is included in the operational literature enclosed with this letter.

Wabtec Railway Electronics has been producing the synthesized digital radio for over 2 years now. The digital radio has been standard equipment on all TrainLink II Head of Train and End of Train devices, domestically and internationally during that time and has provided reliable service since its introduction. There are over 25,000 TrainLink II systems in operation worldwide, including approximately 20,000 on US railroads.

In closing, we thank you and your staff for taking the time to visit with us on this subject and hope the enclosed documentation provides the information needed at this time. Should you or anyone from your staff have any further questions about the TrainLink digital radio and our request for waiver, please feel free to contact me directly @ (301) 762-0108.

Sincerely,

Mark T. Kramer  
Regional Vice President

**SYNTHESIZED RADIO  
FEATURES & BENEFITS  
FOR  
WPN 15622 AND WPN 15623**

**Wabtec Railway Electronics  
21200 Dorsey Mill Road  
Germantown, MD 20876  
Phone: (301) 515-2000  
Fax: (301) 515-2100**



Wabtec Railway Electronics introduces next generation radio for the **TrainLink** product line. New radio is a synthesized radio that automatically and continuously tunes the radio to the correct frequencies and requires no manual adjustments.

#### **FEATURES & BENEFITS:**

- Synthesized UHF Transceiver design
- Tuning range: 450 – 480 MHz (soft configurable)
- Uses existing AAR standard two-way frequencies
- No manual adjustment – software controlled alignment
- RF output power levels (2W / 8W)
- 45 second transmit time out timer
- Auto calibrates (PLL, PA & Driver Bias) after each transmission as needed
- Common card set for LCU and EOT radios
  
- **Fault Detection**
  - Antenna VSWR faults
  - Supply voltage out of tolerance
  - Excessive current draw
  - Auto calibration faults (PLL, Driver Bias, PA Bias)
  - PTT fault
  - RF output power fault
  
- **Maintains an On-Board Operations Log File**
  - Log File Data:
    - *Total elapsed time of radio operation*
    - *System current*
    - *Lowest and Highest temperature encountered*
    - *Number of transmissions*
    - *Auto calibration faults (PLL, Driver Bias, PA Bias)*
    - *Low Battery failures*
    - *Number of PTT time outs in both 2W and 8W mode*
    - *Number of power-on cycles*
    - *Number of auto calibrations performed*
    - *Number of antenna VSWR faults in both 2W and 8W mode*
    - *Number of times transmit power was too high or too low in both 2W and 8W mode*
  
- **Optional Features (Not Currently Implemented)**
  - Buzzer Alarm – Failure mode alert
  - Ability to communicate log data to control system (EOT or LCU), for visual display
  - Remote FLASH software upgrade capability
  
- **Optional Accessories**
  - Windows based Diagnostic Software Suite (including Diagnostics, Troubleshooting, Calibration and Statistical Analysis and Repair Record keeping).
  - Semi-Automated Radio Test Station

For more information, please contact your Wabtec Railway Electronics' sales representative, or contact, (301) 515-2100.

---

Information contained in this document is proprietary and confidential to, and the trade secret of, Wabtec Railway Electronics. No part or the whole of this document may be disclosed outside of Wabtec Railway Electronics without the prior written permission of Wabtec Railway Electronics.

**MFA** **M. Flom Associates, Inc. - Global Compliance Center**  
3356 North San Marcos Place, Suite 107, Chandler, Arizona 85225-7176  
www.mflom.com general@mflom.com (480) 926-3100, FAX: 926-3598

---

Date: November 1, 2001

Federal Communications Commission  
Via: Electronic Filing

Attention: Authorization & Evaluation Division

Applicant: Wabtec Railway Electronics  
Equipment: 15622  
FCC ID: PYI-15622  
FCC Rules: 90, 90.210, Confidentiality

Gentlemen:

On behalf of the Applicant, enclosed please find Application Form 731, Engineering Test Report and all pertinent documentation, the whole for approval of the referenced equipment as shown.

Filing fees are attached.

We trust the same is in order. Should you need any further information, kindly contact the writer who is authorized to act as agent.

Sincerely yours,



Morton Flom, P. Eng.

enclosure(s)  
cc: Applicant  
MF/cvr

LIST OF EXHIBITS  
(FCC CERTIFICATION (TRANSMITTERS) - REVISED 9/28/98)

APPLICANT: Wabtec Railway Electronics

FCC ID: PYI-15622

BY APPLICANT:

- |  |                    |
|--|--------------------|
| 1. LETTER OF AUTHORIZATION   | x                  |
| 2. IDENTIFICATION DRAWINGS, 2.1033(c)(11)                            |                    |
| <input checked="" type="checkbox"/> LABEL                            |                    |
| <input checked="" type="checkbox"/> LOCATION OF LABEL                |                    |
| <input checked="" type="checkbox"/> COMPLIANCE STATEMENT             |                    |
| <input checked="" type="checkbox"/> LOCATION OF COMPLIANCE STATEMENT |                    |
| 3. PHOTOGRAPHS, 2.1033(c)(12)  | x                  |
| 4. DOCUMENTATION: 2.1033(c)  |                    |
| (3) USER MANUAL  | N/A: See Statement |
| (9) TUNE UP INFO   | x                  |
| (10) SCHEMATIC DIAGRAM   | x                  |
| (10) CIRCUIT DESCRIPTION   | x                  |
| BLOCK DIAGRAM  | x                  |
| PARTS LIST   | x                  |
| ACTIVE DEVICES   | x                  |
| 5. PART 90.203(e) & (g) ATTESTATION                                  | x                  |
| 6. Confidentiality Request   | x                  |
| 7. MPE Report  | x                  |
| 8. MX.com, Inc. Mixed Signals ICS MX469                              | x                  |
| 9. Plot showing Transmit Audio Data                                  | x                  |

BY M.F.A. INC.

- A. TESTIMONIAL & STATEMENT OF CERTIFICATION
- B. STATEMENT OF QUALIFICATIONS

**MFA** **M. Flom Associates, Inc. - Global Compliance Center**  
3356 North San Marcos Place, Suite 107, Chandler, Arizona 85225-7176  
www.mflom.com general@mflom.com (480) 926-3100, FAX: 926-3598

---

T R A N S M I T T E R     C E R T I F I C A T I O N

of

FCC ID: PYI-15622  
MODEL: 15622

to

FEDERAL COMMUNICATIONS COMMISSION

Rule Part(s) 90, 90.210, Confidentiality

DATE OF REPORT: November 1, 2001

ON THE BEHALF OF THE APPLICANT:

Wabtec Railway Electronics

AT THE REQUEST OF:

P.O. 0004L

Wabtec Railway Electronics  
21200 Dorsey Mill Road  
Germantown, MD 20876

Attention of:

Ira L. Pollack, Program Manager  
(301) 515-2000; FAX: -2100  
Email: ipollack@wabtec.com  
and/or Clive Wright, Principal Engineer  
(301) 515-2024; FAX: -2150  
Email: cwright@wabtec.com

SUPERVISED BY:



Morton Flom, P. Eng.

THE APPLICANT HAS BEEN CAUTIONED AS TO THE FOLLOWING:

15.21 INFORMATION TO USER.

The users manual or instruction manual for an intentional radiator shall caution the user that changes or modifications not expressly approved by the party responsible for compliance could void the user's authority to operate the equipment.

15.27(a) SPECIAL ACCESSORIES.

Equipment marketed to a consumer must be capable of complying with the necessary regulations in the configuration in which the equipment is marketed. Where special accessories, such as shielded cables and/or special connectors are required to enable an unintentional or intentional radiator to comply with the emission limits in this part, the equipment must be marketed with, i.e. shipped and sold with, those special accessories. However, in lieu of shipping or packaging the special accessories with the unintentional or intentional radiator, the responsible party may employ other methods of ensuring that the special accessories are provided to the consumer, without additional charge.

Information detailing any alternative method used to supply the special accessories for a grant of equipment authorization or retained in the verification records, as appropriate. The party responsible for the equipment, as detailed in § 2.909 of this chapter, shall ensure that these special accessories are provided with the equipment. The instruction manual for such devices shall include appropriate instructions on the first page of text concerned with the installation of the device that these special accessories must be used with the device. It is the responsibility of the user to use the needed special accessories supplied with the equipment.



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Required information per ISO/IEC Guide 25-1990, paragraph 13.2:

a)

TEST REPORT

- b) Laboratory: M. Flom Associates, Inc.  
(FCC: 31040/SIT) 3356 N. San Marcos Place, Suite 107  
(Canada: IC 2044) Chandler, AZ 85225
- c) Report Number: d01b0002
- d) Client: Wabtec Railway Electronics  
21200 Dorsey Mill Road  
Germantown, MD 20876
- e) Identification: 15622  
FCC ID: PYI-15622  
EUT Description: UHF FM Mobile Transceiver
- f) EUT Condition: Not required unless specified in individual tests.
- g) Report Date: November 1, 2001  
EUT Received: October 12, 2001
- h, j, k): As indicated in individual tests.
- i) Sampling method: No sampling procedure used.
- l) Uncertainty: In accordance with MFA internal quality manual.
- m) Supervised by:
- 
- Morton Flom, P. Eng.
- n) Results: The results presented in this report relate only to the item tested.
- o) Reproduction: This report must not be reproduced, except in full, without written permission from this laboratory.

PAGE NO.

2 of 53.

LIST OF GENERAL INFORMATION REQUIRED FOR CERTIFICATIONIN ACCORDANCE WITH FCC RULES AND REGULATIONS,  
VOLUME II, PART 2 AND TO

90, 90.210, Confidentiality

Sub-part 2.1033

(c) (1): NAME AND ADDRESS OF APPLICANT:Wabtec Railway Electronics  
21200 Dorsey Mill Road  
Germantown, MD 20876MANUFACTURER:

Applicant

(c) (2): FCC ID: PYI-15622MODEL NO: 15622(c) (3): INSTRUCTION MANUAL(S):

PLEASE SEE ATTACHED EXHIBITS

(c) (4): TYPE OF EMISSION: 25K2F1D, 12K6F1D, 4K2F1D(c) (5): FREQUENCY RANGE, MHz: 450 to 480(c) (6): POWER RATING, Watts: 2 to 8  
x Switchable      Variable      N/A


FCC GRANT NOTE:

BF - The output power is  
continuously variable from  
the value listed in this  
entry to 20%-25% of the  
value listed.(c) (7): MAXIMUM POWER RATING, Watts: 300DUT RESULTS:Passes   x   Fails

PAGE NO.

3 of 53.

M. Flom Associates, Inc. is accredited by the American Association for Laboratory Association (A2LA) as shown in the scope below.



**THE AMERICAN  
ASSOCIATION  
FOR LABORATORY  
ACCREDITATION**

**ACCREDITED LABORATORY**

A2LA has accredited


**M. FLOM ASSOCIATES, INC.**  
Chandler, AZ

for technical competence in the field of

**Electrical (EMC) Testing**


The accreditation covers the specific tests and types of tests listed on the agreed scope of accreditation. This laboratory meets the requirements of ISO/IEC 17025 - 1999 "General Requirements for the Competence of Testing and Calibration Laboratories" and any additional program requirements in the identified field of testing. Testing and calibration laboratories that comply with this International Standard also operate in accordance with ISO 9001 or ISO 9002.

Presented this 2<sup>nd</sup> day of March, 2001.



President  
For the Accreditation Council  
Certificate Number 1008.01  
Valid to December 31, 2002

For tests or types of tests to which this accreditation applies, please refer to the laboratory's Electrical (EMC) Scope of Accreditation



**American Association for Laboratory Accreditation**

**SCOPE OF ACCREDITATION TO ISO/IEC 17025-1992**


M. FLOM ASSOCIATES, INC.  
Electronic Testing Laboratory  
3356 North San Marcos Place, Suite 107  
Chandler, AZ 85225  
Morton Flom Phone: 480 926 3100

**ELECTRICAL (EMC)**

Valid to: December 31, 2002 Certificate Number: 1008-01

In recognition of the successful completion of the A2LA evaluation process, accreditation is granted to this laboratory to perform the following electromagnetic compatibility tests:

Tests	Standard(s)
RF Emissions	FCC Part 15 (Subparts B and C) using ANSI C63.4-1992; CISPR 11; CISPR 13; CISPR 14; CISPR 22; EN 55011; EN 55013; EN 55014; EN 55022; EN 50081-1; EN 50081-2; ICES-003; AS/NZS 1044; AS/NZS 1033; AS/NZS 3548; AS/NZS 4251.1; CNS 13438
Harmonic Currents	EN 61000-3-2
Fluctuation and Flicker	EN 61000-3-3
RF Immunity	EN: 50082-1, 50082-2 (both excluding "Power Frequency Magnetic Field Immunity" and "Voltage Dips, Short Interruptions, and Line Voltage Variations"); AS/NZS 4251.1
Radiated Susceptibility	EN 61000-4-3; ENV 50140; ENV 50204; IEC 1000-4-3; IEC 801-3
EFT	EN 61000-4-4; IEC 1000-4-4; IEC 801-4
Surge	EN 61000-4-5; ENV 50142; IEC 1000-4-5; IEC 801-5
47 CFR (FCC)	2, 21, 22, 23, 24, 74, 80, 87, 90, 95, 97



5301 Bucknstown Pike, Suite 350 • Frederick, MD 21704-8373 • Phone: 301-644 3248 • Fax: 301-462 2974

"This laboratory is accredited by the American Association for Laboratory Accreditation (A2LA) and the results shown in this report have been determined in accordance with the laboratory's terms of accreditation unless stated otherwise in the report."

Should this report contain any data for tests for which we are not accredited, or which have been undertaken by a subcontractor that is not A2LA accredited, such data would not covered by this laboratory's A2LA accreditation.

PAGE NO.

4 of 53.

Subpart 2.1033 (continued)

(c) (8): VOLTAGES & CURRENTS IN ALL ELEMENTS IN FINAL R. F. STAGE,  
INCLUDING FINAL TRANSISTOR OR SOLID STATE DEVICE:

COLLECTOR CURRENT, A = per manual  
COLLECTOR VOLTAGE, Vdc = per manual  
SUPPLY VOLTAGE, Vdc = 13.0

(c) (9): TUNE-UP PROCEDURE:

PLEASE SEE ATTACHED EXHIBITS

(c) (10): CIRCUIT DIAGRAM/CIRCUIT DESCRIPTION:

Including description of circuitry & devices provided for  
determining and stabilizing frequency, for suppression of  
spurious radiation, for limiting modulation and limiting  
power.

PLEASE SEE ATTACHED EXHIBITS

(c) (11): LABEL INFORMATION:

PLEASE SEE ATTACHED EXHIBITS

(c) (12): PHOTOGRAPHS:

PLEASE SEE ATTACHED EXHIBITS

(c) (13): DIGITAL MODULATION DESCRIPTION:

ATTACHED EXHIBITS  
  x   N/A

(c) (14): TEST AND MEASUREMENT DATA:

FOLLOWS

PAGE NO.

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Sub-part

2.1033(c) (14):

TEST AND MEASUREMENT DATA

All tests and measurement data shown were performed in accordance with FCC Rules and Regulations, Volume II; Part 2, Sub-part J, Sections 2.947, 2.1033(c), 2.1041, 2.1046, 2.1047, 2.1079, 2.1051, 2.1053, 2.1055, 2.1057 and the following individual Parts:

- \_\_\_\_\_ 21 - Domestic Public Fixed Radio Services
- \_\_\_\_\_ 22 - Public Mobile Services
- \_\_\_\_\_ 22 Subpart H - Cellular Radiotelephone Service
- \_\_\_\_\_ 22.901(d) - Alternative technologies and auxiliary services
- \_\_\_\_\_ 23 - International Fixed Public Radiocommunication services
- \_\_\_\_\_ 24 - Personal Communications Services
- \_\_\_\_\_ 74 Subpart H - Low Power Auxiliary Stations
- \_\_\_\_\_ 80 - Stations in the Maritime Services
- \_\_\_\_\_ 80 Subpart E - General Technical Standards
- \_\_\_\_\_ 80 Subpart F - Equipment Authorization for Compulsory Ships
- \_\_\_\_\_ 80 Subpart K - Private Coast Stations and Marine Utility Stations
- \_\_\_\_\_ 80 Subpart S - Compulsory Radiotelephone Installations for Small Passenger Boats
- \_\_\_\_\_ 80 Subpart T - Radiotelephone Installation Required for Vessels on the Great Lakes
- \_\_\_\_\_ 80 Subpart U - Radiotelephone Installations Required by the Bridge-to-Bridge Act
- \_\_\_\_\_ 80 Subpart V - Emergency Position Indicating Radiobeacons (EPIRB'S)
- \_\_\_\_\_ 80 Subpart W - Global Maritime Distress and Safety System (GMDSS)
- \_\_\_\_\_ 80 Subpart X - Voluntary Radio Installations
- \_\_\_\_\_ 87 - Aviation Services
- x   90 - Private Land Mobile Radio Services
- \_\_\_\_\_ 94 - Private Operational-Fixed Microwave Service
- \_\_\_\_\_ 95 Subpart A - General Mobile Radio Service (GMRS)
- \_\_\_\_\_ 95 Subpart C - Radio Control (R/C) Radio Service
- \_\_\_\_\_ 95 Subpart D - Citizens Band (CB) Radio Service
- \_\_\_\_\_ 95 Subpart E - Family Radio Service
- \_\_\_\_\_ 95 Subpart F - Interactive Video and Data Service (IVDS)
- \_\_\_\_\_ 97 - Amateur Radio Service
- \_\_\_\_\_ 101 - Fixed Microwave Services

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STANDARD TEST CONDITIONS  
and  
ENGINEERING PRACTICES

Except as noted herein, the following conditions and procedures were observed during the testing:

In accordance with ANSI C63.4-1992/2000 Draft, section 6.1.9, and unless otherwise indicated in the specific measurement results, the ambient temperature of the actual EUT was maintained within the range of 10° to 40°C (50° to 104 °F) unless the particular equipment requirements specify testing over a different temperature range. Also, unless otherwise indicated, the humidity levels were in the range of 10% to 90% relative humidity.

Prior to testing, the EUT was tuned up in accordance with the manufacturer's alignment procedures. All external gain controls were maintained at the position of maximum and/or optimum gain throughout the testing.

Measurement results, unless otherwise noted, are worst case measurements.

PAGE NO. 7 of 53.  
NAME OF TEST: Carrier Output Power (Conducted)  
SPECIFICATION: 47 CFR 2.1046(a)  
GUIDE: ANSI/TIA/EIA-603-1992, Paragraph 2.2.1  
TEST EQUIPMENT: As per attached page

MEASUREMENT PROCEDURE

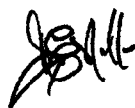
1. The EUT was connected to a resistive coaxial attenuator of normal load impedance, and the unmodulated output power was measured by means of an R. F. Power Meter.
2. Measurement accuracy is  $\pm 3\%$ .

MEASUREMENT RESULTS  
(Worst case)

FREQUENCY OF CARRIER, MHz = 450.0125, 450.025, 450.0750,  
450.1125, 465.0875, 479.9000,  
479.8625

POWER SETTING	R. F. POWER, WATTS
Low	2
High	8

PERFORMED BY:

  
Doug Noble, B.A.S. E.E.T.

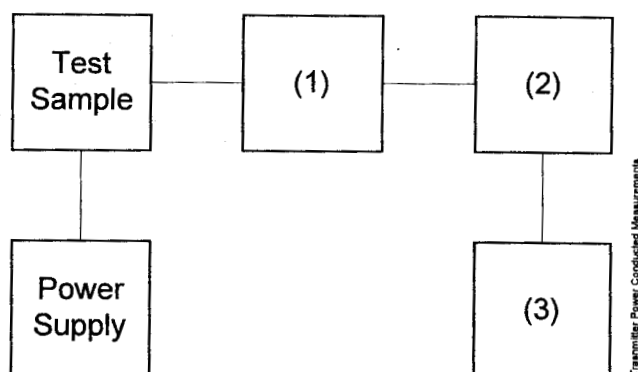


PAGE NO.

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TRANSMITTER POWER CONDUCTED MEASUREMENTS

TEST 1: R. F. POWER OUTPUT  
 TEST 2: FREQUENCY STABILITY



Asset Description (as applicable)	s/n
(1) <u>COAXIAL ATTENUATOR</u>	
i00122 Narda 766-10	7802
i00123 Narda 766-10	7802A
i00069 Bird 8329 (30 dB)	1006
i00113 Sierra 661A-3D	1059
(2) <u>POWER METERS</u>	
i00014 HP 435A	1733A05836
i00039 HP 436A	2709A26776
i00020 HP 8901A POWER MODE	2105A01087
(3) <u>FREQUENCY COUNTER</u>	
i00042 HP 5383A	1628A00959
i00019 HP 5334B	2704A00347
i00020 HP 8901A FREQUENCY MODE	2105A01087

PAGE NO.

9 of 53.

NAME OF TEST:

ERP Carrier Power (Radiated)

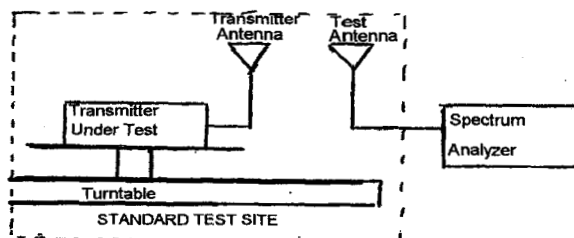
SPECIFICATION:

TIA/EIA 603A (Substitution Method)

2.2.17.1 Definition: The average radiated power of a licensed device is the equivalent power required, when delivered to a half-wave dipole or horn antenna, to produce at a distant point the same average received power as produced by the licensed device.

2.2.17.2 Method of Measurement:

a) Connect the equipment as illustrated. Place the transmitter to be tested on the turntable in the standard test site.



b) Raise and lower the test antenna from 1m to 6 m with the transmitter facing the antenna and record the highest received signal in dB as LVL.

c) Repeat step b) for seven additional readings at 45° interval positions of the turntable.

d) Replace the transmitter under test with a half-wave or horn vertically polarized antenna. The center of the antenna should be at the same location as the transmitter under test. Connect the antenna to a signal generator with a known output power and record the path loss in dB or LOSS.

e) Calculate the average radiated output power from the readings in step c) and d) by the following:

$$\text{average radiated power} = 10 \log_{10} \Sigma 10(\text{LVL} - \text{LOSS})/10 \text{ (dBm)}$$

	RESULTS			Path Loss, db
	450.013 MHZ LVL, dbm	465.08 MHz LVL, dbm	479.900 MHz LVL, dbm	
0°	35.2	36.9	36.9	1.8
45°	34.3	36.4	35.5	1.8
90°	33.9	35.8	34.0	1.8
135°	33.8	36.0	35.1	1.8
180°	33.8	36.5	36.1	1.8
225°	34.4	34.8	35.8	1.8
270°	34.2	35.4	35.6	1.8
315°	33.9	35.1	35.5	1.8
<hr/>				
	450.013 MHZ	465.08 MHz	479.900 MHz	
Av. Radiated Power:	35.95 dbm	37.66 dbm	37.36 dbm	

PAGE NO. 10 of 53.  
NAME OF TEST: Unwanted Emissions (Transmitter Conducted)  
SPECIFICATION: 47 CFR 2.1051  
GUIDE: ANSI/TIA/EIA-603-1992, Paragraph 2.2.13  
TEST EQUIPMENT: As per attached page

MEASUREMENT PROCEDURE

1. The emissions were measured for the worst case as follows:  
(a): within a band of frequencies defined by the carrier frequency plus and minus one channel.  
(b): from the lowest frequency generated in the EUT and to at least the 10th harmonic of the carrier frequency, or 40 GHz, whichever is lower.
2. The magnitude of spurious emissions that are attenuated more than 20 dB below the permissible value need not be specified.
3. MEASUREMENT RESULTS: ATTACHED FOR WORST CASE

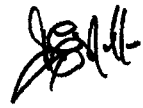
FREQUENCY OF CARRIER, MHz = 450.0125, 450.025, 450.0750,  
450.1125, 465.0875, 479.9000,  
479.8625

SPECTRUM SEARCHED, GHz = 0 to 10 x  $F_c$

MAXIMUM RESPONSE, Hz = (Data) N/A

ALL OTHER EMISSIONS =  $\geq 20$  dB BELOW LIMIT

PERFORMED BY:

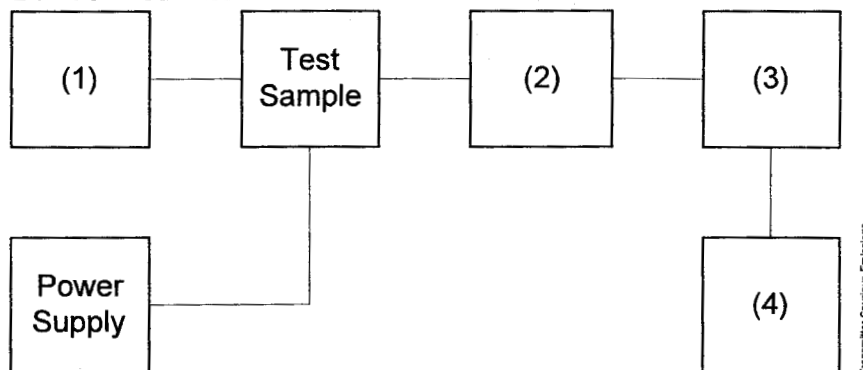
  
Doug Noble, B.A.S. E.E.T.

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TRANSMITTER SPURIOUS EMISSION

TEST A. OCCUPIED BANDWIDTH (IN-BAND SPURIOUS)  
 TEST B. OUT-OF-BAND SPURIOUS



Asset Description (as applicable)	s/n
(1) <u>AUDIO OSCILLATOR/GENERATOR</u>	
i00010 HP 204D	1105A04683
i00017 HP 8903A	2216A01753
i00012 HP 3312A	1432A11250
(2) <u>COAXIAL ATTENUATOR</u>	
i00122 Narda 766-10	7802
i00123 Narda 766-10	7802A
i00069 Bird 8329 (30 dB)	1006
i00113 Sierra 661A-3D	1059
(3) <u>FILTERS; NOTCH, HP, LP, BP</u>	
i00126 Eagle TNF-1	100-250
i00125 Eagle TNF-1	50-60
i00124 Eagle TNF-1	250-850
(4) <u>SPECTRUM ANALYZER</u>	
i00048 HP 8566B	2511A01467
i00029 HP 8563E	3213A00104

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NAME OF TEST:

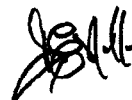
Unwanted Emissions (Transmitter Conducted)

LIMIT(S), dBc:  $-(50+10 \times \text{LOG } P) = -53$  (2 Watts)  
 $-(50+10 \times \text{LOG } P) = -59$  (8 Watts)

Unit #1	Type	Frequency	Modulation	Peak Dev. kHz	RF Output Watts
	F1	450.0250	MSK 1200BPS	3.0	2.0
	F1	450.0250	MSK 1200BPS	3.0	8.0
	F2	465.0875	MSK 1200BPS	3.0	2.0
	F2	465.0875	MSK 1200BPS	3.0	8.0

g01a0071: 2001-Oct-17 Wed 08:48:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	LEVEL, dBm	LEVEL, dBc	MARGIN, dB
450.025000	900.091000	-42.7	-75.7	-22.7
465.087500	930.568000	-42.5	-75.5	-22.5
450.025000	1350.028000	-42.6	-75.6	-22.6
465.087500	1395.390000	-42	-75	-22
450.025000	1800.593000	-41.1	-74.1	-21.1
465.087500	1860.602000	-41.9	-74.9	-21.9
450.025000	2250.153000	-41.7	-74.7	-21.7
465.087500	2325.209000	-40.3	-73.3	-20.3
450.025000	2700.226000	-43.2	-76.2	-23.2
465.087500	2790.515000	-44	-77	-24
450.025000	3149.830000	-43.9	-76.9	-23.9
465.087500	3255.758000	-43.8	-76.8	-23.8
450.025000	3600.107000	-43.9	-76.9	-23.9
465.087500	3720.510000	-43.9	-76.9	-23.9
450.025000	4050.201000	-44.2	-77.2	-24.2
465.087500	4186.170000	-43	-76	-23
450.025000	4500.686000	-43.7	-76.7	-23.7
465.087500	4650.449000	-42.5	-75.5	-22.5
450.025000	4950.006000	-44.1	-77.1	-24.1
465.087500	5115.700000	-44.9	-77.9	-24.9
450.025000	5400.136000	-44.2	-77.2	-24.2
465.087500	5581.478600	-43.4	-76.4	-23.4
450.025000	5850.000000	-35.9	-68.9	-15.9
465.087500	6046.616100	-36.2	-69.2	-16.2
450.025000	6300.839000	-37.6	-70.6	-17.6
465.087500	6510.806200	-38.7	-71.7	-18.7
450.025000	6750.615000	-37.1	-70.1	-17.1
465.087500	6975.920700	-37.3	-70.3	-17.3



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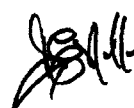
NAME OF TEST: Unwanted Emissions (Transmitter Conducted)

LIMIT(S), dBc:  $-(50+10 \times \text{LOG } P) = -53$  (2 Watts)  
 $-(50+10 \times \text{LOG } P) = -59$  (8 Watts)

Unit #1	Type	Frequency	Modulation	Peak Dev. kHz	RF Output Watts
	F1	450.0250	MSK 1200BPS	3.0	2.0
	F1	450.0250	MSK 1200BPS	3.0	8.0
	F2	465.0875	MSK 1200BPS	3.0	2.0
	F2	465.0875	MSK 1200BPS	3.0	8.0

g01a0070: 2001-Oct-17 Wed 08:46:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	LEVEL, dBm	LEVEL, dBc	MARGIN, dB
450.025000	900.063000	-26.7	-65.7	-6.7
465.087500	930.178000	-32.5	-71.5	-12.5
450.025000	1350.088000	-37.6	-76.6	-17.6
465.087500	1395.276000	-38.9	-77.9	-18.9
450.025000	1800.111000	-41.8	-80.8	-21.8
465.087500	1860.351000	-40.6	-79.6	-20.6
450.025000	2250.411000	-41.4	-80.4	-21.4
465.087500	2325.449000	-39.3	-78.3	-19.3
450.025000	2700.032000	-42.9	-81.9	-22.9
465.087500	2790.155000	-44.2	-83.2	-24.2
450.025000	3150.267000	-44.1	-83.1	-24.1
465.087500	3255.655000	-43.8	-82.8	-23.8
450.025000	3600.223000	-43.2	-82.2	-23.2
465.087500	3721.195000	-41.7	-80.7	-21.7
450.025000	4050.490000	-43.6	-82.6	-23.6
465.087500	4185.885000	-43.3	-82.3	-23.3
450.025000	4500.299000	-43.7	-82.7	-23.7
465.087500	4651.036000	-44.5	-83.5	-24.5
450.025000	4950.318000	-44	-83	-24
465.087500	5116.420000	-42.9	-81.9	-22.9
450.025000	5400.676000	-43	-82	-23
465.087500	5581.134100	-43.2	-82.2	-23.2
450.025000	5850.288000	-37.2	-76.2	-17.2
465.087500	6046.624000	-38	-77	-18
450.025000	6300.427000	-38.2	-77.2	-18.2
465.087500	6511.515400	-38	-77	-18
450.025000	6750.081000	-38.2	-77.2	-18.2
465.087500	6976.635200	-38	-77	-18



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NAME OF TEST: Unwanted Emissions (Transmitter Conducted)

LIMIT(S), dBc:  $-(50+10 \times \text{LOG } P) = -53$  (2 Watts)  
 $-(50+10 \times \text{LOG } P) = -59$  (8 Watts)

Unit #2	Type	Frequency	Modulation	Peak Dev. kHz	RF Output Watts
	F1	450.1125	GMSK 9600BPS	1.5	2.0
	F1	450.1125	GMSK 9600BPS	1.5	8.0
	F2	479.9250	GMSK 19200BPS	3.0	2.0
	F2	479.9250	GMSK 19200BPS	3.0	8.0

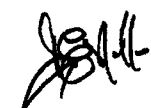
g01a0069: 2001-Oct-16 Tue 15:53:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	LEVEL, dBm	LEVEL, dBc	MARGIN, dB
450.112500	900.635000	-42.7	-75.7	-22.7
450.112500	1349.867000	-42.4	-75.4	-22.4
450.112500	1800.255000	-41.6	-74.6	-21.6
450.112500	2250.421000	-41	-74	-21
450.112500	2701.004000	-43.2	-76.2	-23.2
450.112500	3150.531000	-44.2	-77.2	-24.2
450.112500	3600.564000	-42.5	-75.5	-22.5
450.112500	4050.736000	-43	-76	-23
450.112500	4501.096000	-43.6	-76.6	-23.6
450.112500	4951.445000	-42.4	-75.4	-22.4
450.112500	5401.463900	-43.7	-76.7	-23.7
450.112500	5851.580000	-37.8	-70.8	-17.8
450.112500	6301.601000	-38.8	-71.8	-18.8
450.112500	6752.012000	-38.1	-71.1	-18.1

g01a0057: 2001-Oct-16 Tue 13:09:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	LEVEL, dBm	LEVEL, dBc	MARGIN, dB
479.925000	959.453000	-42.6	-75.6	-22.6
479.925000	1440.075000	-41.9	-74.9	-21.9
479.925000	1920.168000	-41.5	-74.5	-21.5
479.925000	2399.884000	-40.5	-73.5	-20.5
479.925000	2879.638000	-43.5	-76.5	-23.5
479.925000	3359.012000	-43.8	-76.8	-23.8
479.925000	3839.314000	-42.7	-75.7	-22.7
479.925000	4319.241000	-42.5	-75.5	-22.5
479.925000	4799.021000	-43.7	-76.7	-23.7
479.925000	5279.035000	-43.3	-76.3	-23.3
479.925000	5759.274000	-43.5	-76.5	-23.5
479.925000	6238.906000	-37.5	-70.5	-17.5
479.925000	6719.363000	-36.9	-69.9	-16.9
479.925000	7199.062000	-37.4	-70.4	-17.4

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MFA p01a0005, d01b0002

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NAME OF TEST: Unwanted Emissions (Transmitter Conducted)

LIMIT(S), dBc:  $-(50+10 \times \log P) = -53$  (2 Watts)  
 $-(50+10 \times \log P) = -59$  (8 Watts)

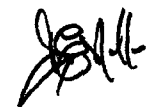
Unit #2	Type	Frequency	Modulation	Peak Dev. kHz	RF Output Watts
	F1	450.1125	GMSK 9600BPS	1.5	2.0
	F1	450.1125	GMSK 9600BPS	1.5	8.0
	F2	479.9250	GMSK 19200BPS	3.0	2.0
	F2	479.9250	GMSK 19200BPS	3.0	8.0

g01a0068: 2001-Oct-16 Tue 15:51:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	LEVEL, dBm	LEVEL, dBc	MARGIN, dB
450.112500	900.232000	-27.8	-66.8	-7.8
450.112500	1350.343000	-38.1	-77.1	-18.1
450.112500	1800.412000	-41.9	-80.9	-21.9
450.112500	2250.365000	-41.3	-80.3	-21.3
450.112500	2700.572000	-43.2	-82.2	-23.2
450.112500	3150.379000	-44	-83	-24
450.112500	3600.771000	-44.3	-83.3	-24.3
450.112500	4050.880000	-43.3	-82.3	-23.3
450.112500	4500.815000	-44.2	-83.2	-24.2
450.112500	4950.927000	-43	-82	-23
450.112500	5401.519300	-43.5	-82.5	-23.5
450.112500	5851.301000	-37.5	-76.5	-17.5
450.112500	6301.404000	-37.3	-76.3	-17.3
450.112500	6751.974000	-38.1	-77.1	-18.1

g01a0056: 2001-Oct-16 Tue 13:10:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	LEVEL, dBm	LEVEL, dBc	MARGIN, dB
479.925000	959.864000	-31	-70	-11
479.925000	1439.782000	-36.7	-75.7	-16.7
479.925000	1919.719000	-40.6	-79.6	-20.6
479.925000	2399.622000	-32.6	-71.6	-12.6
479.925000	2879.550000	-43.8	-82.8	-23.8
479.925000	3359.228000	-44.2	-83.2	-24.2
479.925000	3839.653000	-43.6	-82.6	-23.6
479.925000	4319.799000	-44.2	-83.2	-24.2
479.925000	4799.161000	-43.6	-82.6	-23.6
479.925000	5279.154000	-43.1	-82.1	-23.1
479.925000	5758.923000	-44	-83	-24
479.925000	6239.028000	-38.8	-77.8	-18.8
479.925000	6718.672000	-37.2	-76.2	-17.2
479.925000	7198.709000	-37.3	-76.3	-17.3



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MFA p01a0005, d01b0002



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NAME OF TEST:

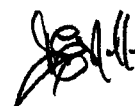
Unwanted Emissions (Transmitter Conducted)

LIMIT(S), dBc:  $-(50+10 \times \log P) = -53$  (2 Watts) $-(50+10 \times \log P) = -59$  (8 Watts)

Unit #3	Type	Frequency	Modulation	Peak Dev. kHz	RF Output Watts
	F1	450.0125	MSK 1200BPS	1.5	2.0
	F1	450.0125	MSK 1200BPS	1.5	8.0
	F2	479.9000	MSK 1200BPS	3.0	2.0
	F2	479.9000	MSK 1200BPS	3.0	8.0

g01a0067: 2001-Oct-16 Tue 15:37:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	LEVEL, dBm	LEVEL, dBc	MARGIN, dB
450.012500	900.037000	-41.5	-74.5	-21.5
479.900000	959.769000	-43.4	-76.4	-23.4
450.012500	1349.628000	-42.6	-75.6	-22.6
479.900000	1439.662000	-41.3	-74.3	-21.3
450.012500	1800.010000	-42.2	-75.2	-22.2
479.900000	1919.283000	-41.8	-74.8	-21.8
450.012500	2249.913000	-41.7	-74.7	-21.7
479.900000	2399.703000	-39.9	-72.9	-19.9
450.012500	2699.850000	-43.1	-76.1	-23.1
479.900000	2879.214000	-42.2	-75.2	-22.2
450.012500	3150.546000	-43.8	-76.8	-23.8
479.900000	3359.443000	-44.6	-77.6	-24.6
450.012500	3600.001000	-43.5	-76.5	-23.5
479.900000	3838.711000	-44.4	-77.4	-24.4
450.012500	4050.146000	-44	-77	-24
479.900000	4318.846000	-43.1	-76.1	-23.1
450.012500	4500.360000	-43.9	-76.9	-23.9
479.900000	4799.226000	-43.6	-76.6	-23.6
450.012500	4950.311000	-43.5	-76.5	-23.5
479.900000	5278.625000	-43.2	-76.2	-23.2
450.012500	5400.577700	-43.6	-76.6	-23.6
479.900000	5759.072000	-43	-76	-23
450.012500	5849.994000	-37.6	-70.6	-17.6
479.900000	6238.365000	-37.6	-70.6	-17.6
450.012500	6300.039000	-37.4	-70.4	-17.4
479.900000	6718.230000	-37.2	-70.2	-17.2
450.012500	6750.283000	-37.6	-70.6	-17.6
479.900000	7198.569000	-38	-71	-18



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NAME OF TEST:

Unwanted Emissions (Transmitter Conducted)

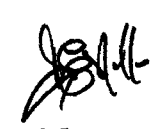
LIMIT(S), dBc:  $-(50+10 \times \text{LOG } P) = -53$  (2 Watts) $-(50+10 \times \text{LOG } P) = -59$  (8 Watts)

Unit #3	Type	Frequency	Modulation	Peak Dev. kHz	RF Output Watts
	F1	450.0125	MSK 1200BPS	1.5	2.0
	F1	450.0125	MSK 1200BPS	1.5	8.0
	F2	479.9000	MSK 1200BPS	3.0	2.0
	F2	479.9000	MSK 1200BPS	3.0	8.0

g01a0066: 2001-Oct-16 Tue 15:36:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	LEVEL, dBm	LEVEL, dBc	MARGIN, dB
450.012500	900.032000	-25	-64	-5
479.900000	959.808000	-40.6	-79.6	-20.6
450.012500	1350.036000	-38.6	-77.6	-18.6
479.900000	1439.717000	-36	-75	-16
450.012500	1800.054000	-41.3	-80.3	-21.3
479.900000	1919.861000	-41.5	-80.5	-21.5
450.012500	2249.980000	-41.8	-80.8	-21.8
479.900000	2399.516000	-29.6	-68.6	-9.6
450.012500	2699.702000	-42.3	-81.3	-22.3
479.900000	2879.045000	-43.8	-82.8	-23.8
450.012500	3150.130000	-43.8	-82.8	-23.8
479.900000	3358.974000	-44.1	-83.1	-24.1
450.012500	3600.400000	-44.6	-83.6	-24.6
479.900000	3839.678000	-44.4	-83.4	-24.4
450.012500	4050.123000	-43.5	-82.5	-23.5
479.900000	4319.094000	-43.2	-82.2	-23.2
450.012500	4499.831000	-43.4	-82.4	-23.4
479.900000	4798.583000	-43.6	-82.6	-23.6
450.012500	4949.858000	-43.6	-82.6	-23.6
479.900000	5278.500000	-43.6	-82.6	-23.6
450.012500	5399.956000	-43.3	-82.3	-23.3
479.900000	5758.645000	-43.2	-82.2	-23.2
450.012500	5850.078000	-37	-76	-17
479.900000	6238.701000	-38.6	-77.6	-18.6
450.012500	6300.417000	-38.6	-77.6	-18.6
479.900000	6718.987000	-38.1	-77.1	-18.1
450.012500	6750.264000	-38.2	-77.2	-18.2
479.900000	7198.526000	-37.6	-76.6	-17.6

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NAME OF TEST: Field Strength of Spurious Radiation

SPECIFICATION: 47 CFR 2.1053(a)

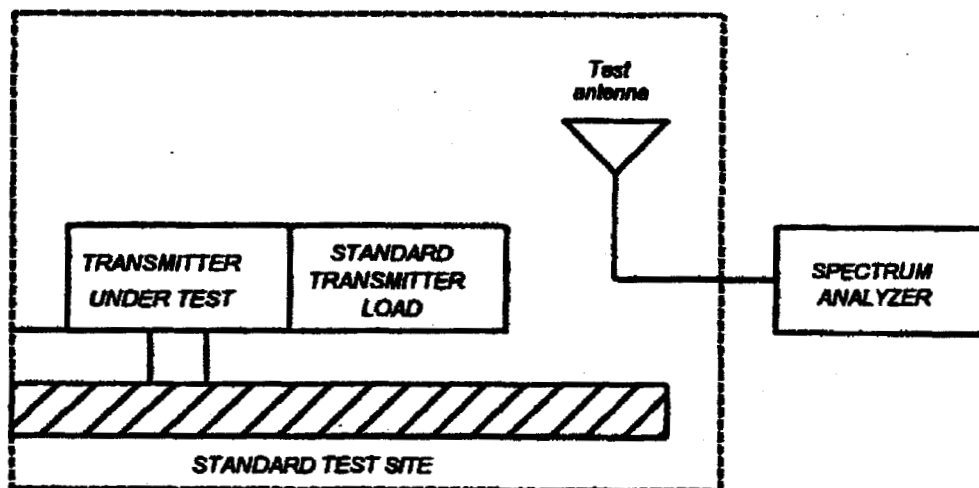
GUIDE: ANSI/TIA/EIA-603-1992, Paragraph 1.2.12

MEASUREMENT PROCEDURE

1.2.12.1 Definition: Radiated spurious emissions are emissions from the equipment when transmitting into a non-radiating load on a frequency or frequencies which are outside an occupied band sufficient to ensure transmission of information of required quality for the class of communications desired.

1.2.12.2 Method of Measurement

- A) Connect the equipment as illustrated
- B) Adjust the spectrum analyzer for the following settings:
  - 1) Resolution Bandwidth  $\leq 3$  kHz.
  - 2) Video Bandwidth  $\geq 10$  kHz
  - 3) Sweep Speed  $\leq 2000$  Hz/second
  - 4) Detector Mode = Positive Peak
- C) Place the transmitter to be tested on the turntable in the standard test site. The transmitter is transmitting into a non-radiating load which is placed on the turntable. The RF cable to this load should be of minimum length.

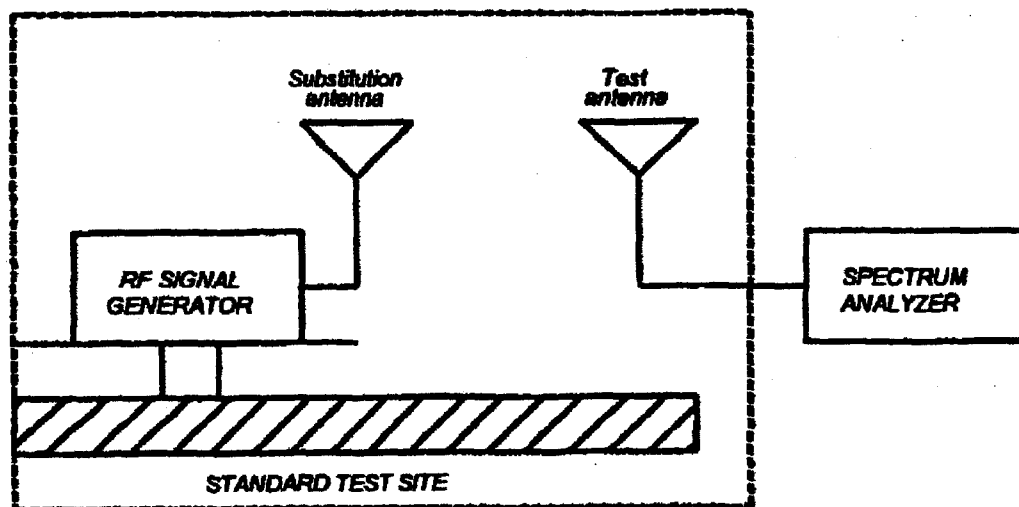


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NAME OF TEST: Field Strength of Spurious Radiation (Cont.)

- D) For each spurious measurement the test antenna should be adjusted to the correct length for the frequency involved. This length may be determined from a calibration ruler supplied with the equipment. Measurements shall be made from the lowest radio frequency generated in the equipment to the tenth harmonic of the carrier, except for the region close to the carrier equal to  $\pm$  the test bandwidth (see section 1.3.4.4).
- E) For each spurious frequency, raise and lower the test antenna from 1 m to 4 m to obtain a maximum reading on the spectrum analyzer with the test antenna at horizontal polarity. Repeat this procedure to obtain the highest possible reading. Record this maximum reading.
- F) Repeat step E) for each spurious frequency with the test antenna polarized vertically.



- G) Reconnect the equipment as illustrated.
- H) Keep the spectrum analyzer adjusted as in step B).
- I) Remove the transmitter and replace it with a substitution antenna (the antenna should be half-wavelength for each frequency involved). The center of the substitution antenna should be approximately at the same location as the center of the transmitter. At lower frequencies, where the substitution antenna is very long, this will be impossible to achieve when the antenna is polarized vertically. In such case the lower end of the antenna should be 0.3 m above the ground.

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NAME OF TEST: Field Strength of Spurious Radiation (Cont.)

- J) Feed the substitution antenna at the transmitter end with a signal generator connected to the antenna by means of a non-radiating cable. With the antennas at both ends horizontally polarized and with the signal generator tuned to a particular spurious frequency, raise and lower the test antenna to obtain a maximum reading at the spectrum analyzer. Adjust the level of the signal generator output until the previously recorded maximum reading for this set of conditions is obtained. This should be done carefully repeating the adjustment of the test antenna and generator output.
- K) Repeat step J) with both antennas vertically polarized for each spurious frequency.
- L) Calculate power in dBm into a reference ideal half-wave dipole antenna by reducing the readings obtained in steps J) and K) by the power loss in the cable between the generator and the antenna and further corrected for the gain of the substitution antenna used relative to an ideal half-wave dipole antenna.
- M) The levels recorded in step L) are absolute levels of radiated spurious emissions in dBm. The radiated spurious emissions in dB can be calculated by the following:

Radiated spurious emissions dB =  
 $10 \log_{10}(\text{TX power in watts}/0.001) - \text{the levels in step l})$

NOTE: It is permissible that other antennas provided can be referenced to a dipole.

## Test Equipment:

Asset Description (as applicable)	s/n	Cycle	Last Cal
<u>TRANSDUCER</u>			
i00088 EMCO 3109-B 25MHz-300MHz	2336	12 mo.	Sep-01
i00065 EMCO 3301-B Active Monopole	2635	12 mo.	Sep-01
i00089 April 2001 200MHz-1GHz	001500	12 mo.	Sep-01
i00103 EMCO 3115 1GHz-18GHz	9208-3925	12 mo.	Sep-01
<u>AMPLIFIER</u>			
i00028 HP 8449A	2749A00121	12 mo.	Mar-01
<u>SPECTRUM ANALYZER</u>			
i00029 HP 8563E	3213A00104	12 mo.	Aug-01
i00033 HP 85462A	3625A00357	12 mo.	May-01
i00048 HP 8566B	2511AD1467	6 mo.	Nov-01
<u>MICROPHONE, ANTENNA PORT, AND CABELING</u>			
Microphone	Yes/No <u>Y</u>	Cable Length <u>1</u> Meters	
Antenna Port Terminated	Yes/No <u>Y</u>	Antenna Gain <u>0</u> dBd	
All Ports Terminated by	Load <u>N</u>		

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NAME OF TEST:

Field Strength of Spurious Radiation

Low Power g01a0090: 2001-Oct-19 Fri 13:45:00

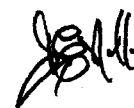
FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	ERP, dBm	ERP, dBc
450.012500	900.017800	-43.2	≤ -63.1
450.012500	1350.035800	-25.7	≤ -63.1
450.012500	1800.047500	-39.3	≤ -63.1
450.012500	2250.061300	-48.4	≤ -63.1
450.012500	2700.068800	-34.2	≤ -63.1
450.012500	3150.082833	-24.1	≤ -63.1
450.012500	3600.094333	-50.9	≤ -63.1
450.012500	4050.119167	-45.5	≤ -63.1
450.012500	4500.118667	-50.5	≤ -63.1

Low Power g01a0091: 2001-Oct-19 Fri 14:07:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	ERP, dBm	ERP, dBc
465.087500	930.171300	-48.1	≤ -59.7
465.087500	1395.267500	-20.7	≤ -59.7
465.087500	2325.444900	-37.4	≤ -59.7
465.087500	2790.548900	-38.7	≤ -59.7
465.087500	3255.612500	-46.2	≤ -59.7
465.087500	3720.675000	-52.8	≤ -59.7
465.087500	4185.785000	-46.2	≤ -59.7
465.087500	4650.889166	-48.5	≤ -59.7
465.087500	5115.988000	-49.6	≤ -59.7

High Power g01a0089: 2001-Oct-19 Fri 13:30:00

FREQUENCY TUNED, MHz	FREQUENCY EMISSION, MHz	ERP, dBm	ERP, dBc
479.900000	959.808800	-33.6	≤ -68.3
479.900000	1439.715000	-35.4	≤ -68.3
479.900000	1919.597500	-29.3	≤ -68.3
479.900000	2399.504500	-35.9	≤ -68.3
479.900000	2879.408500	-34.6	≤ -68.3
479.900000	3359.293333	-42.6	≤ -68.3
479.900000	3839.198667	-46.4	≤ -68.3
479.900000	4319.096500	-51.7	≤ -68.3
479.900000	4798.983667	-48.6	≤ -68.3



SUPERVISED BY:

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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
SPECIFICATION: 47 CFR 2.1049(c) (1)  
GUIDE: ANSI/TIA/EIA-603-1992, Paragraph 2.2.11  
TEST EQUIPMENT: As per previous page

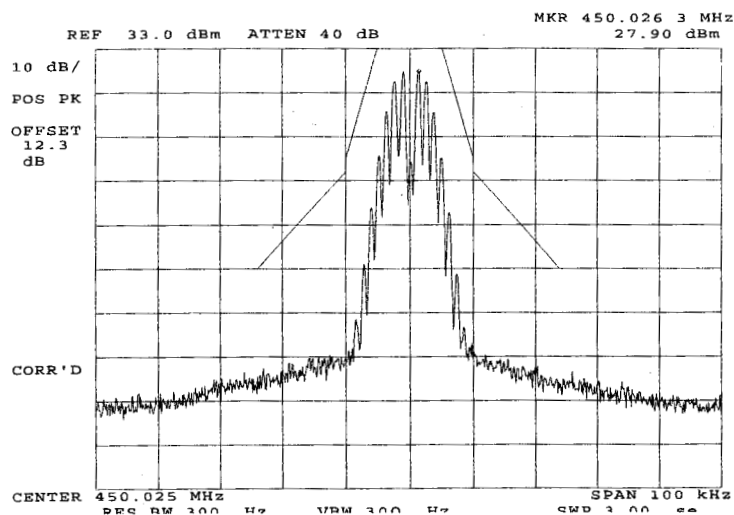
MEASUREMENT PROCEDURE

1. The EUT and test equipment were set up as shown on the following page, with the Spectrum Analyzer connected.
2. For EUTs supporting audio modulation, the audio signal generator was adjusted to the frequency of maximum response and with output level set for  $\pm 2.5/\pm 1.25$  kHz deviation (or 50% modulation). With level constant, the signal level was increased 16 dB.
3. For EUTs supporting digital modulation, the digital modulation mode was operated to its maximum extent.
4. The Occupied Bandwidth was measured with the Spectrum Analyzer controls set as shown on the test results.
5. MEASUREMENT RESULTS: ATTACHED

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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0040: 2001-Oct-16 Tue 11:14:00  
STATE: 1:Low Power



POWER: LOW LCU #1  
MODULATION: MSK @ 1200 BPS 1.2K MARK 450.025 MHZ  
MASK: C, VHF/UHF 25kHz, no LPF

PERFORMED BY:

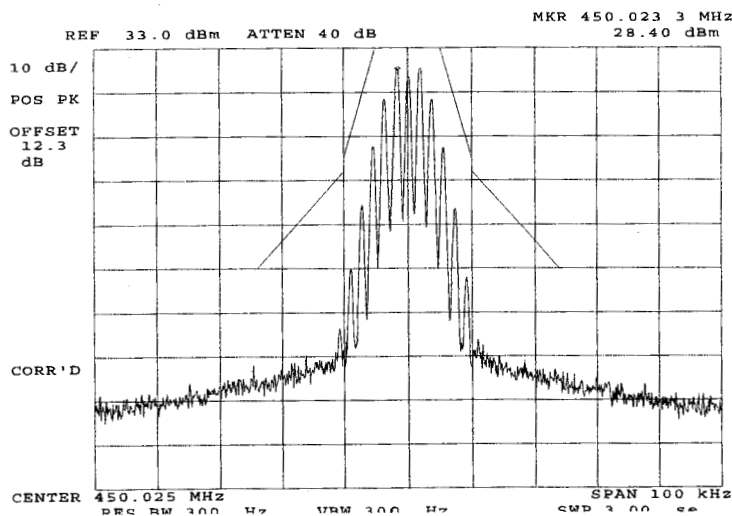
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0041: 2001-Oct-16 Tue 11:26:00  
STATE: 1:Low Power



POWER: LOW LCU #1  
MODULATION: MSK @ 1200 BPS 1.8K FREQ. = 450.025 MHz  
MASK: C, VHF/UHF 25kHz, no LPF

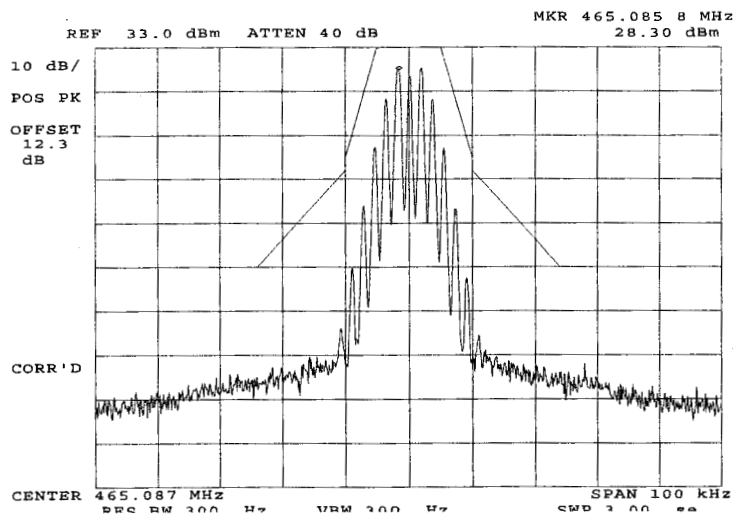
PERFORMED BY:

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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0044: 2001-Oct-16 Tue 11:33:00  
STATE: 1:Low Power



POWER: LOW LCU #1  
MODULATION: MSK @ 1200 BPS 1.8K FREQ. = 465.0875 MHZ  
MASK: C, VHF/UHF 25kHz, no LPF

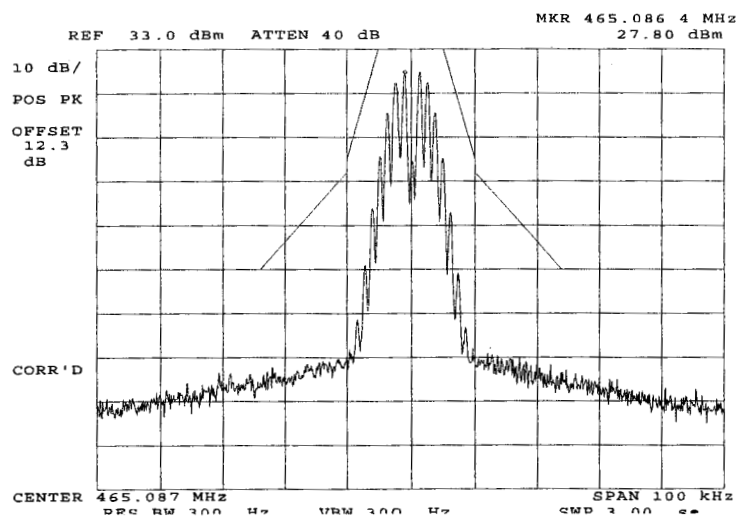
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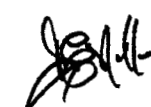
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0045: 2001-Oct-16 Tue 11:34:00  
STATE: 1:Low Power



POWER: LOW LCU #1  
MODULATION: MSK @ 1200 BPS 1.2K FREQ. = 465.0875 MHZ  
MASK: C, VHF/UHF 25kHz, no LPF

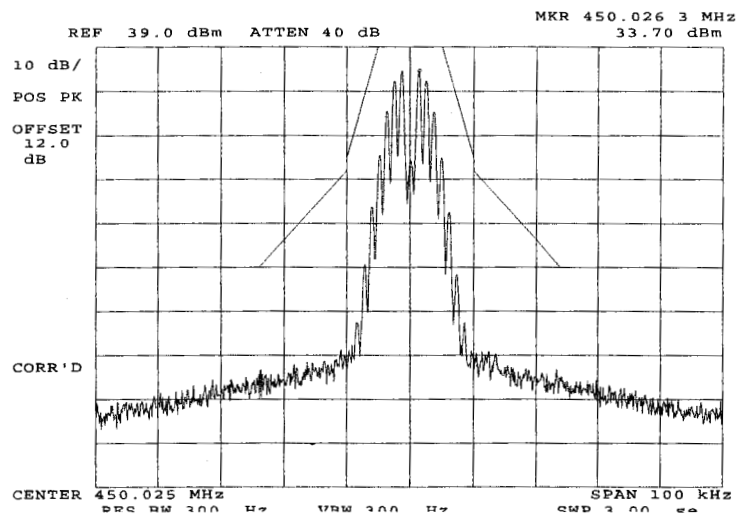
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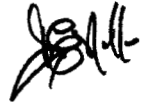
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0039: 2001-Oct-16 Tue 11:05:00  
STATE: 2:High Power



POWER: HIGH LCU #1  
MODULATION: MSK @ 1200 BPS 1.2K MARK 450.025 MHZ  
MASK: C, VHF/UHF 25kHz, no LPF

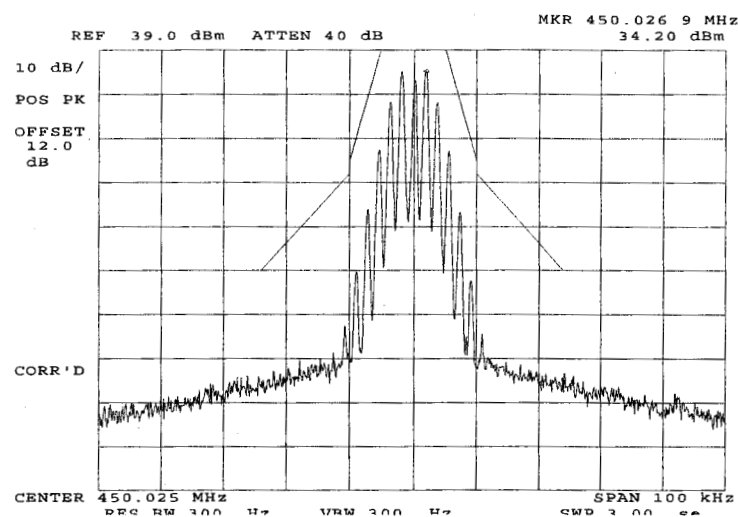
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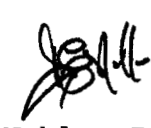
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0042: 2001-Oct-16 Tue 11:28:00  
STATE: 2:High Power



POWER: HIGH LCU #1  
MODULATION: MSK @ 1200 BPS 1.8K FREQ. = 450.025 MHZ  
MASK: C, VHF/UHF 25kHz, no LPF

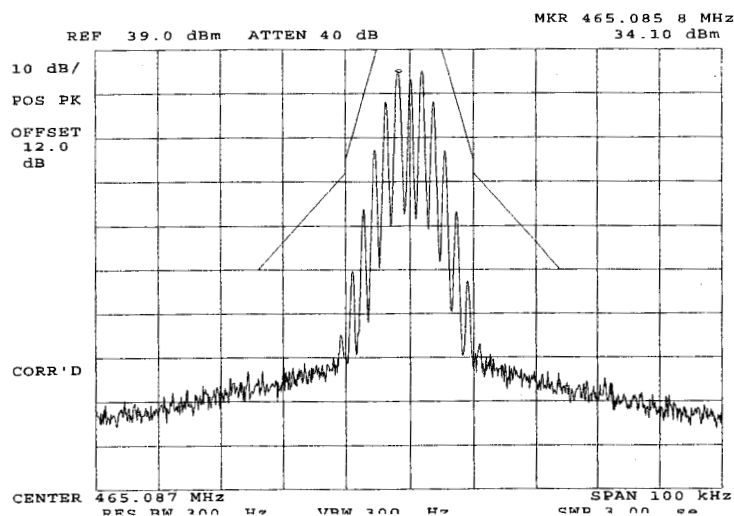
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0043: 2001-Oct-16 Tue 11:31:00  
STATE: 2:High Power



POWER: HIGH LCU #1  
MODULATION: MSK @ 1200 BPS 1.8K FREQ. = 465.0875 MHZ  
MASK: C, VHF/UHF 25kHz, no LPF

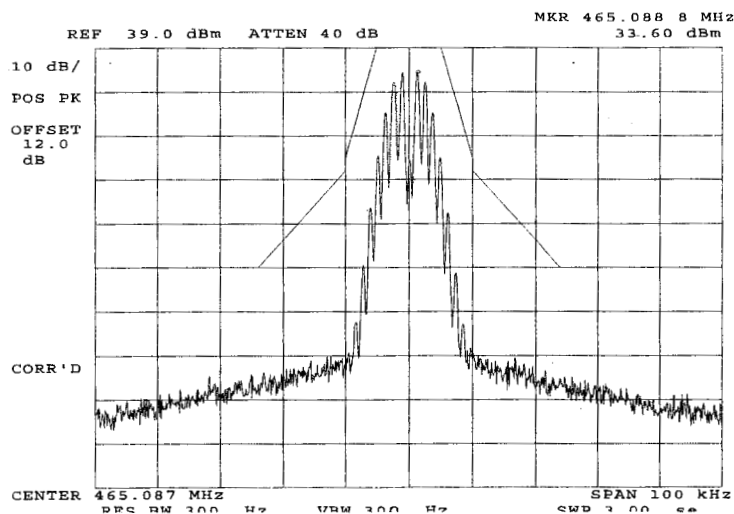
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0046: 2001-Oct-16 Tue 11:36:00  
STATE: 2:High Power



POWER: HIGH LCU #1  
MODULATION: MSK @ 1200 BPS 1.2K FREQ. = 465.0875 MHz  
MASK: C, VHF/UHF 25kHz, no LPF

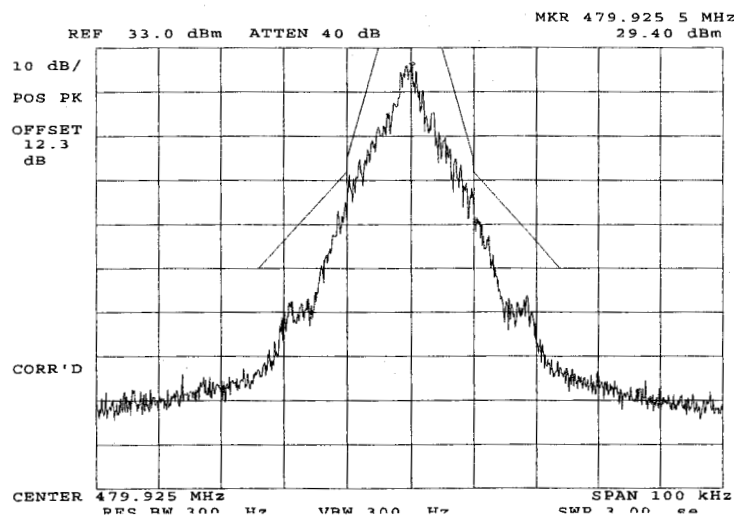
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0048: 2001-Oct-16 Tue 12:06:00  
STATE: 1:Low Power



POWER: LOW LCU #2  
MODULATION: GMSK @ 19200 BPS - 479.9250 MHz  
MASK: C, VHF/UHF 25kHz, no LPF

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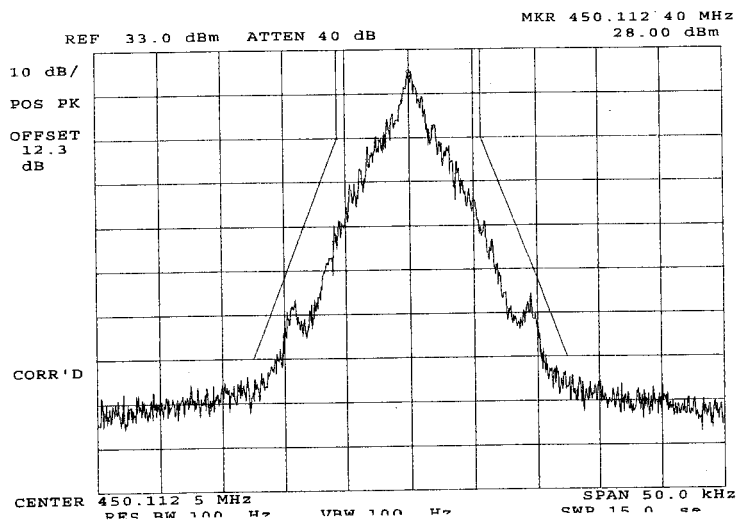
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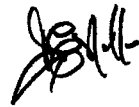
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0049: 2001-Oct-16 Tue 12:11:00  
STATE: 1:Low Power



POWER: LOW LCU #2  
MODULATION: GMSK @ 9600 BPS - 450.1125 MHz  
MASK: D, VHF/UHF 12.5kHz BW

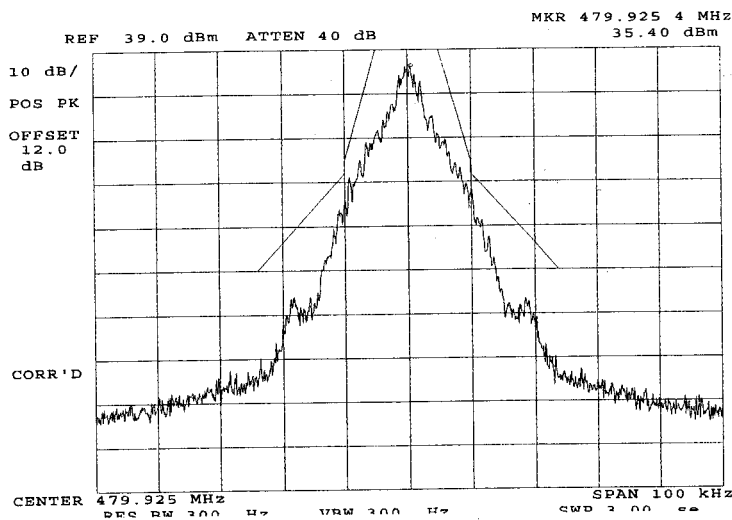
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0047: 2001-Oct-16 Tue 12:04:00  
STATE: 2:High Power



POWER: HIGH LCU #2  
MODULATION: GMSK @ 19200 BPS - 479.9250 MHz  
MASK: C, VHF/UHF 25kHz, no LPF

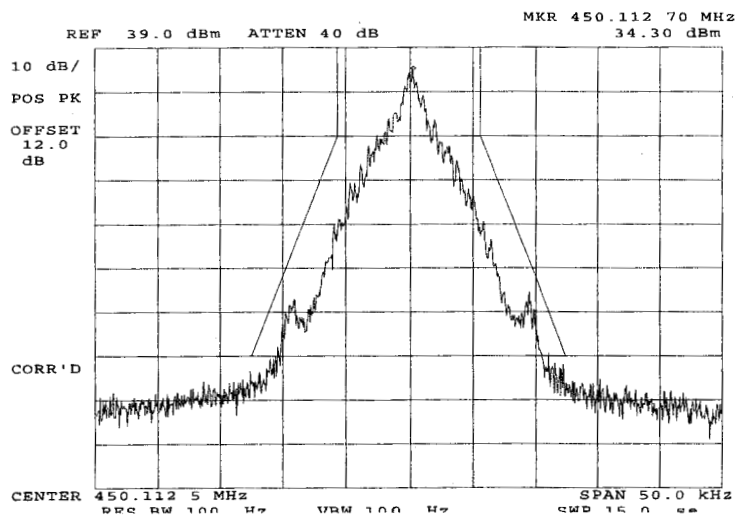
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0050: 2001-Oct-16 Tue 12:13:00  
STATE: 2:High Power



POWER: HIGH LCU #2  
MODULATION: GMSK @ 9600 BPS - 450.1125 MHz  
MASK: D, VHF/UHF 12.5kHz BW

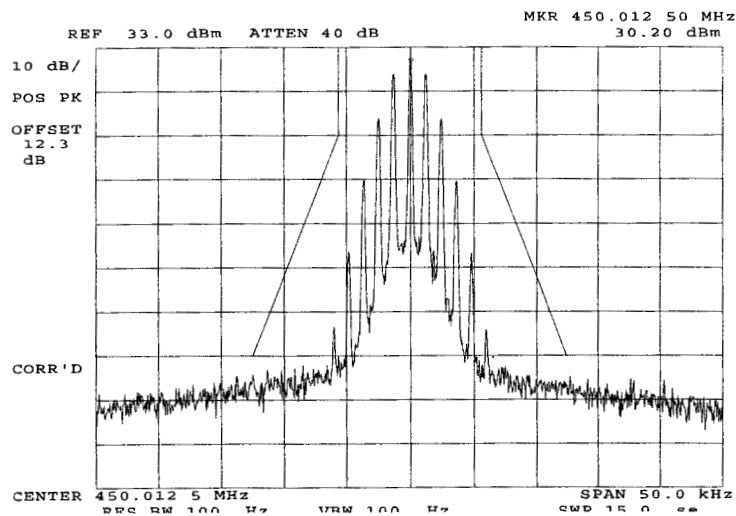
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0058: 2001-Oct-16 Tue 14:49:00  
STATE: 1:Low Power



POWER: LOW LCU #3  
MODULATION: MSK 1200 BPS, 1.2K MARK, 450.0125 MHz  
MASK: D, VHF/UHF 12.5kHz BW

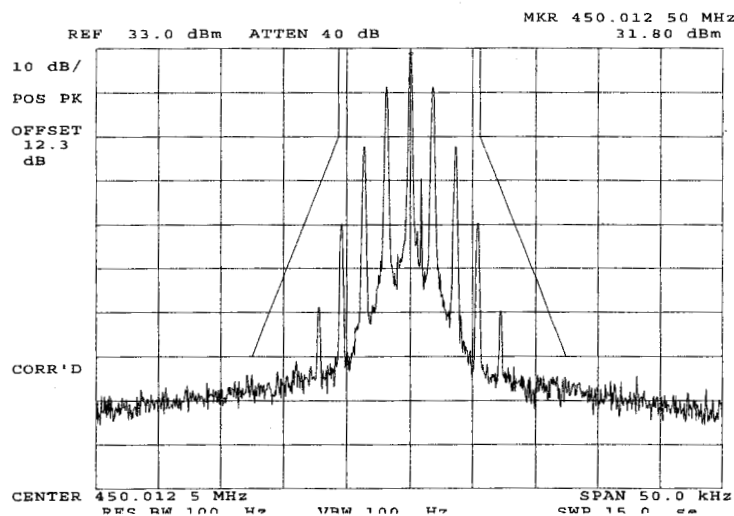
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0061: 2001-Oct-16 Tue 14:57:00  
STATE: 1:Low Power



POWER: LOW LCU #3  
MODULATION: MSK 1200 BPS, 1.8K MARK, 450.0125 MHz  
MASK: D, VHF/UHF 12.5kHz BW

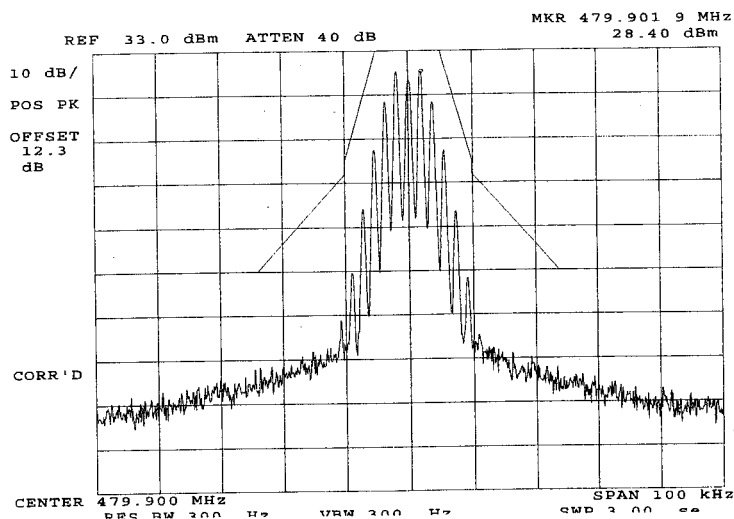
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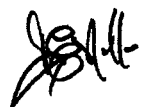
37 of 53.

NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0062: 2001-Oct-16 Tue 15:01:00  
STATE: 1:Low Power



POWER: LOW LCU #3  
MODULATION: MSK 1200 BPS, 1.8K MARK, 479.9000 MHZ  
MASK: C, VHF/UHF 25kHz, no LPF

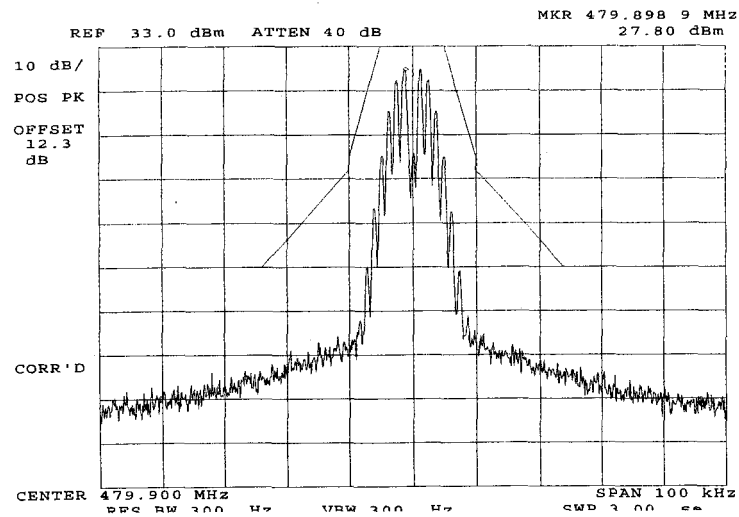
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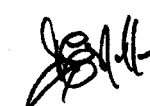
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0065: 2001-Oct-16 Tue 15:04:00  
STATE: 1:Low Power



POWER: LOW LCU #3  
MODULATION: MSK 1200 BPS, 1.2K MARK, 479.9000 MHZ  
MASK: C, VHF/UHF 25kHz, no LPF

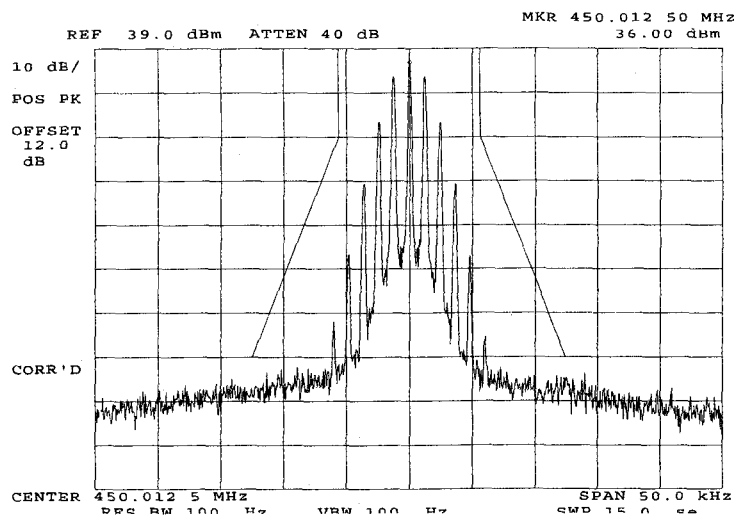
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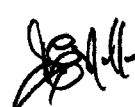
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0059: 2001-Oct-16 Tue 14:51:00  
STATE: 2:High Power



POWER: HIGH LCU #3  
MODULATION: MSK 1200 BPS, 1.2K MARK, 450.0125 MHz  
MASK: D, VHF/UHF 12.5kHz BW

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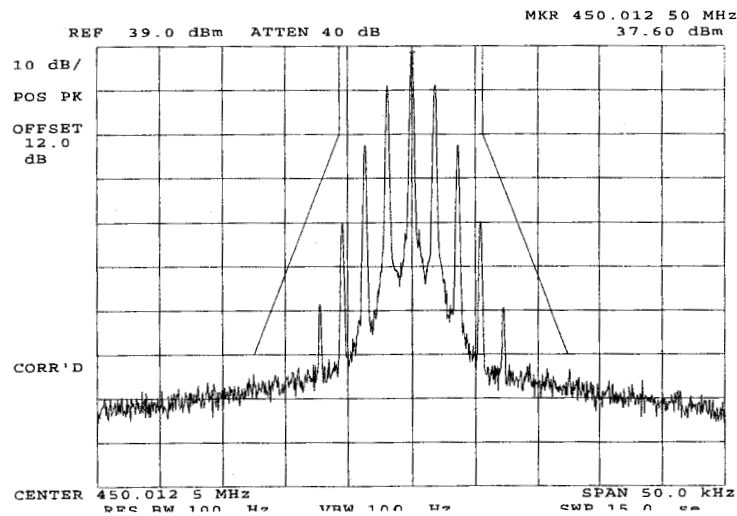
  
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0060: 2001-Oct-16 Tue 14:55:00  
STATE: 2:High Power



POWER: HIGH LCU #3  
MODULATION: MSK 1200 BPS, 1.8K MARK, 450.0125 MHz  
MASK: D, VHF/UHF 12.5kHz BW

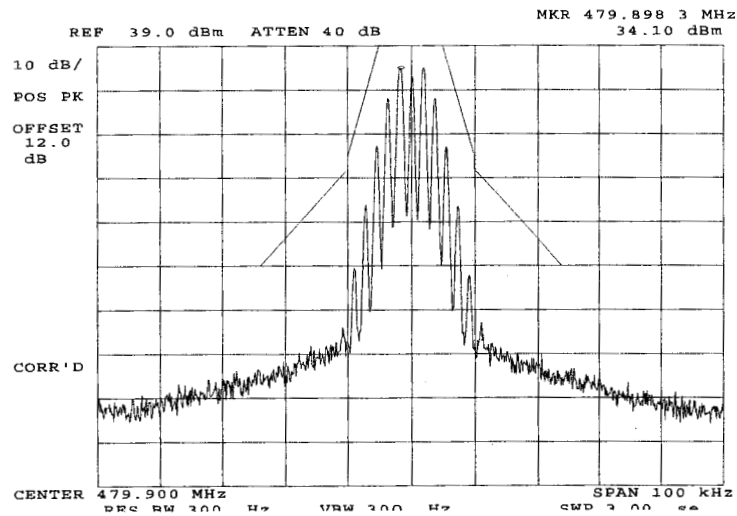
PERFORMED BY:

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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0063: 2001-Oct-16 Tue 15:02:00  
STATE: 2:High Power



POWER: HIGH LCU #3  
MODULATION: MSK 1200 BPS, 1.8K MARK, 479.9000 MHZ  
MASK: C, VHF/UHF 25kHz, no LPF

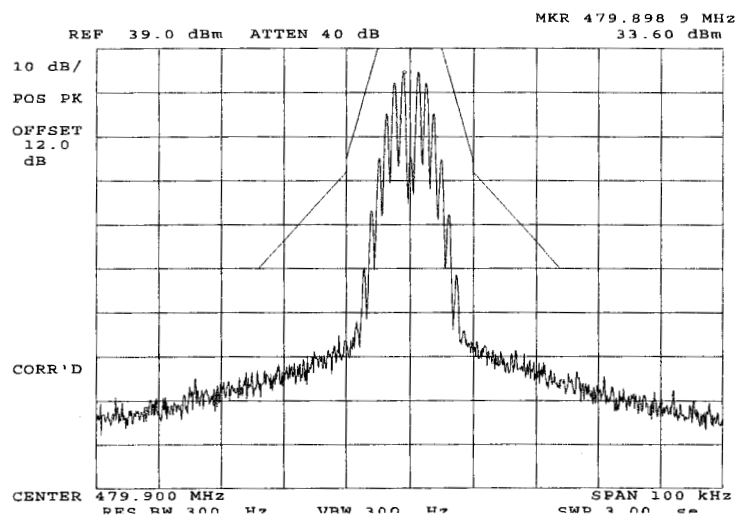
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NAME OF TEST: Emission Masks (Occupied Bandwidth)  
g01a0064: 2001-Oct-16 Tue 15:03:00  
STATE: 2:High Power



POWER: HIGH LCU #3  
MODULATION: MSK 1200 BPS, 1.2K MARK, 479.9000 MHz  
MASK: C, VHF/UHF 25kHz, no LPF

PERFORMED BY:

  
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NAME OF TEST: Transient Frequency Behavior  
SPECIFICATION: 47 CFR 90.214  
GUIDE: ANSI/TIA/EIA-603-1992, Paragraph 2.2.19  
TEST EQUIPMENT: As per attached page

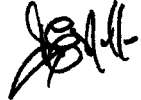
MEASUREMENT PROCEDURE

1. The EUT was setup as shown on the attached page, following TIA/EIA-603 steps a, b, and c as a guide.
2. The transmitter was turned on.
3. Sufficient attenuation was provided so that the transmitter carrier level measured at the output of the combiner was 40 dB below the maximum input level of the test receiver. This level was recorded as step f.
4. The transmitter was turned off.
5. An RF signal generator (1) modulated with a 1 kHz tone at either 25, 12.5, or 6.25 kHz deviation, and set to the same frequency as the assigned transmitter frequency, (2) was adjusted to a level -20 dB below the level recorded for step f, as measured at the output of the combiner. This level was then fixed for the remainder of the test and is recorded at step h.
6. The oscilloscope was setup using TIA/EIA-603 steps j and k as a guide, and to either 10 ms/div (UHF) or 5 ms/div (VHF).
7. The 30 dB attenuator was removed, the transmitter was turned on, and the level of the carrier at the output of the combiner was recorded as step l.
8. The carrier on-time as referenced in TIA/EIA-603 steps m, n, and o was captured and plotted. The carrier off-time as referenced in TIA/EIA-603 steps p, q, r, and s was captured and plotted.

LEVELS MEASURED:

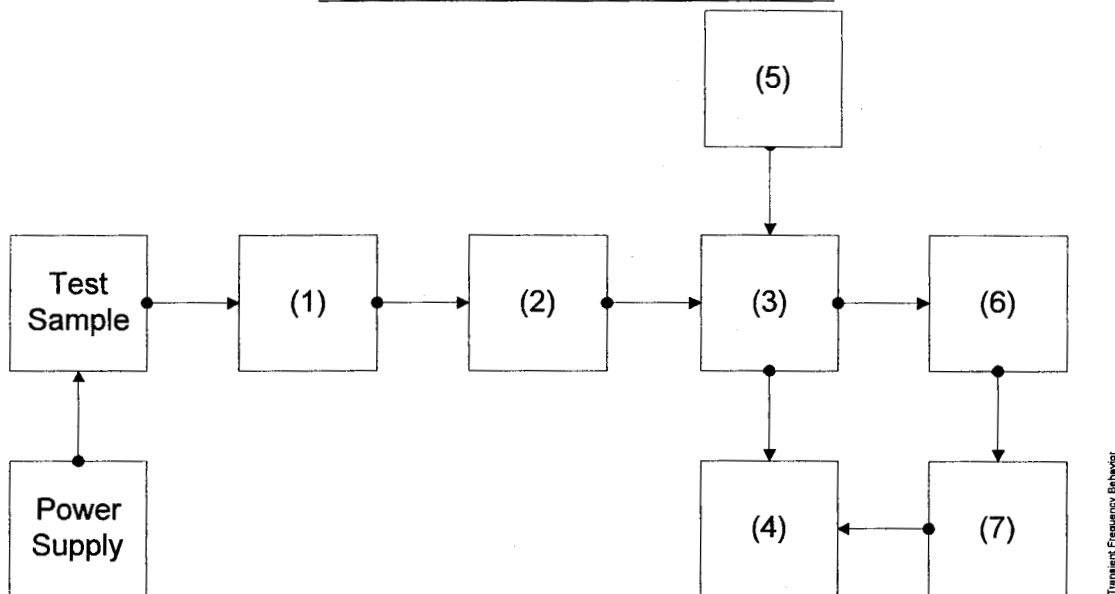
<u>step f</u> , dBm	= -1.01
<u>step h</u> , dBm	= -42.49
<u>step l</u> , dBm	= 7.67

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TRANSIENT FREQUENCY BEHAVIOR

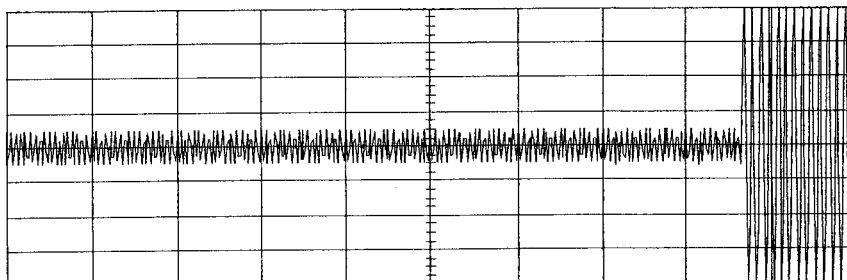
Asset	Description (as applicable)	s/n
(1)	<u>ATTENUATOR</u> (Removed after 1st step)	
	i00112 Philco 30 dB	989
(2)	<u>ATTENUATOR</u>	
	i00112 Philco 30 dB	989
	i00172 Bird 30 dB	989
	i00122 Narda 10 dB	7802
	i00123 Narda 10 dB	7802A
	i00110 Kay Variable	145-387
(3)	<u>COMBINER</u>	
	i00154 4 x 25 $\Omega$ COMBINER	154
(4)	<u>CRYSTAL DETECTOR</u>	
	i00159 HP 8470B	1822A10054
(5)	<u>RF SIGNAL GENERATOR</u>	
	i00018 HP 8656A	2228A03472
	i00031 HP 8656A	2402A06180
	i00067 HP 8920A	3345U01242
(6)	<u>MODULATION ANALYZER</u>	
	i00020 HP 8901A	2105A01087
(7)	<u>SCOPE</u>	
	i00030 HP 54502A	2927A00209



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NAME OF TEST: Transient Frequency Behavior  
g01a0101: 2001-Oct-30 Tue 12:29:00  
STATE: 2:High Power

[illegible]

POWER:  
MODULATION:  
DESCRIPTION:

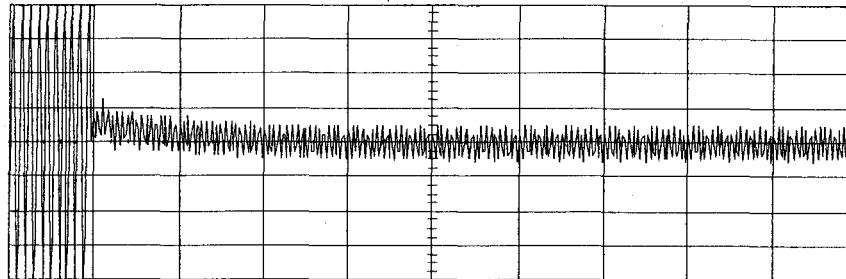
HIGH  
Ref Gen=25 kHz Deviation  
CARRIER OFF TIME

PERFORMED BY:

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NAME OF TEST: Transient Frequency Behavior  
g01a0102: 2001-Oct-30 Tue 12:57:00  
STATE: 2:High Power



Year	Production (million tons)	Production (million tons)	Production (million tons)	Production (million tons)
1950	1.0	1.0	1.0	1.0
1951	1.0	1.0	1.0	1.0
1952	1.0	1.0	1.0	1.0
1953	1.0	1.0	1.0	1.0
1954	1.0	1.0	1.0	1.0
1955	1.0	1.0	1.0	1.0
1956	1.0	1.0	1.0	1.0
1957	1.0	1.0	1.0	1.0
1958	1.0	1.0	1.0	1.0
1959	1.0	1.0	1.0	1.0
1960	1.0	1.0	1.0	1.0
1961	1.0	1.0	1.0	1.0
1962	1.0	1.0	1.0	1.0
1963	1.0	1.0	1.0	1.0
1964	1.0	1.0	1.0	1.0
1965	1.0	1.0	1.0	1.0
1966	1.0	1.0	1.0	1.0
1967	1.0	1.0	1.0	1.0
1968	1.0	1.0	1.0	1.0
1969	1.0	1.0	1.0	1.0
1970	1.0	1.0	1.0	1.0
1971	1.0	1.0	1.0	1.0
1972	1.0	1.0	1.0	1.0
1973	1.0	1.0	1.0	1.0
1974	1.0	1.0	1.0	1.0
1975	1.0	1.0	1.0	1.0
1976	1.0	1.0	1.0	1.0
1977	1.0	1.0	1.0	1.0
1978	1.0	1.0	1.0	1.0
1979	1.0	1.0	1.0	1.0
1980	1.0	1.0	1.0	1.0
1981	1.0	1.0	1.0	1.0
1982	1.0	1.0	1.0	1.0
1983	1.0	1.0	1.0	1.0
1984	1.0	1.0	1.0	1.0
1985	1.0	1.0	1.0	1.0
1986	1.0	1.0	1.0	1.0
1987	1.0	1.0	1.0	1.0
1988	1.0	1.0	1.0	1.0
1989	1.0	1.0	1.0	1.0
1990	1.0	1.0	1.0	1.0
1991	1.0	1.0	1.0	1.0
1992	1.0	1.0	1.0	1.0
1993	1.0	1.0	1.0	1.0
1994	1.0	1.0	1.0	1.0
1995	1.0	1.0	1.0	1.0
1996	1.0	1.0	1.0	1.0
1997	1.0	1.0	1.0	1.0
1998	1.0	1.0	1.0	1.0
1999	1.0	1.0	1.0	1.0
2000	1.0	1.0	1.0	1.0
2001	1.0	1.0	1.0	1.0
2002	1.0	1.0	1.0	1.0
2003	1.0	1.0	1.0	1.0
2004	1.0	1.0	1.0	1.0
2005	1.0	1.0	1.0	1.0
2006	1.0	1.0	1.0	1.0
2007	1.0	1.0	1.0	1.0
2008	1.0	1.0	1.0	1.0
2009	1.0	1.0	1.0	1.0
2010	1.0	1.0	1.0	1.0
2011	1.0	1.0	1.0	1.0
2012	1.0	1.0	1.0	1.0
2013	1.0	1.0	1.0	1.0
2014	1.0	1.0	1.0	1.0
2015	1.0	1.0	1.0	1.0
2016	1.0	1.0	1.0	1.0
2017	1.0	1.0	1.0	1.0
2018	1.0	1.0	1.0	1.0
2019	1.0	1.0	1.0	1.0
2020	1.0	1.0	1.0	1.0
2021	1.0	1.0	1.0	1.0
2022	1.0	1.0	1.0	1.0
2023	1.0	1.0	1.0	1.0
2024	1.0	1.0	1.0	1.0
2025	1.0	1.0	1.0	1.0

POWER:  
MODULATION:  
DESCRIPTION:

HIGH  
Ref Gen=12.5 kHz Deviation  
CARRIER ON TIME

PERFORMED BY:

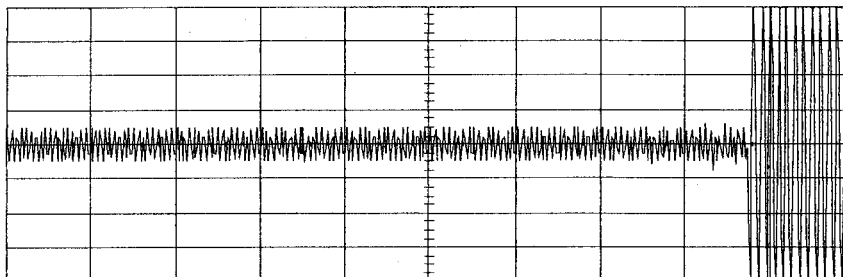
Doug Noble, B.A.S. E.E.T.



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NAME OF TEST: Transient Frequency Behavior  
 g01a0103: 2001-Oct-30 Tue 12:59:00  
 STATE: 2:High Power

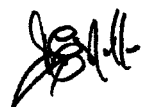


Modulation: 12.5 kHz  
 Power: 100 W  
 Frequency: 100 MHz  
 Bandwidth: 100 kHz  
 Resolution: 100 Hz  
 Sweep: 100 Hz  
 Reference: 100 Hz  
 Scale: 100 dB  
 Units: dBm

POWER:  
 MODULATION:  
 DESCRIPTION:

HIGH  
 Ref Gen=12.5 kHz Deviation  
 CARRIER OFF TIME

PERFORMED BY:

  
 Doug Noble, B.A.S. E.E.T.

PAGE NO. 49 of 53.

NAME OF TEST: Frequency Stability (Temperature Variation)

SPECIFICATION: 47 CFR 2.1055(a)(1)

GUIDE: ANSI/TIA/EIA-603-1992, Paragraph 2.2.2

TEST CONDITIONS: As Indicated

TEST EQUIPMENT: As per previous page

MEASUREMENT PROCEDURE

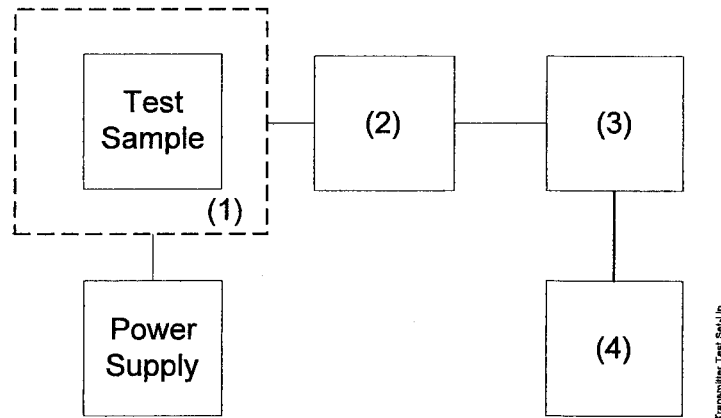
1. The EUT and test equipment were set up as shown on the following page.
2. With all power removed, the temperature was decreased to -30°C and permitted to stabilize for three hours. Power was applied and the maximum change in frequency was noted within one minute.
3. With power OFF, the temperature was raised in 10°C steps. The sample was permitted to stabilize at each step for at least one-half hour. Power was applied and the maximum frequency change was noted within one minute.
4. The temperature tests were performed for the worst case.
5. MEASUREMENT RESULTS: ATTACHED

PAGE NO.

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TRANSMITTER TEST SET-UP

TEST A. OPERATIONAL STABILITY  
 TEST B. CARRIER FREQUENCY STABILITY  
 TEST C. OPERATIONAL PERFORMANCE STABILITY  
 TEST D. HUMIDITY  
 TEST E. VIBRATION  
 TEST F. ENVIRONMENTAL TEMPERATURE  
 TEST G. FREQUENCY STABILITY: TEMPERATURE VARIATION  
 TEST H. FREQUENCY STABILITY: VOLTAGE VARIATION

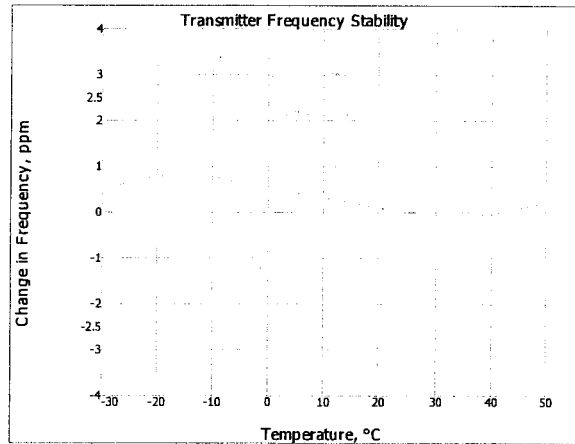


Asset	Description (as applicable)	s/n
(1)	<u>TEMPERATURE, HUMIDITY, VIBRATION</u>	
i00027	Tenney Temp. Chamber	9083-765-234
i00	Weber Humidity Chamber	
i00	L.A.B. RVH 18-100	
(2)	<u>COAXIAL ATTENUATOR</u>	
i00122	NARDA 766-10	7802
i00123	NARDA 766-10	7802A
i00113	SIERRA 661A-3D	1059
i00069	BIRD 8329 (30 dB)	10066
(3)	<u>R.F. POWER</u>	
i00014	HP 435A POWER METER	1733A05839
i00039	HP 436A POWER METER	2709A26776
i00020	HP 8901A POWER MODE	2105A01087
(4)	<u>FREQUENCY COUNTER</u>	
i00042	HP 5383A	1628A00959
i00019	HP 5334B	2704A00347
i00020	HP 8901A	2105A01087


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NAME OF TEST: Frequency Stability (Temperature Variation)  
g01a0032: 2001-Oct-17 Wed 14:14:38  
STATE: 0:General



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MFA p01a0005, d01b0002

PAGE NO. 52 of 53.  
NAME OF TEST: Frequency Stability (Voltage Variation)  
SPECIFICATION: 47 CFR 2.1055(d) (1)  
GUIDE: ANSI/TIA/EIA-603-1992, Paragraph 2.2.2  
TEST EQUIPMENT: As per previous page

MEASUREMENT PROCEDURE


1. The EUT was placed in a temperature chamber at 25±5°C and connected as for "Frequency Stability - Temperature Variation" test.
2. The power supply voltage to the EUT was varied from 85% to 115% of the nominal value measured at the input to the EUT.
3. The variation in frequency was measured for the worst case.

RESULTS: Frequency Stability (Voltage Variation)  
 g01a0072: 2001-Oct-17 Wed 09:13:46  
 STATE: 0:General

LIMIT, ppm = 2.5  
 LIMIT, Hz = 1163  
 BATTERY END POINT (Voltage) = 10.4

% of STV	Voltage	Frequency, MHz	Change, Hz	Change, ppm
85	11.05	465.087490	-10	-0.02
100	13	465.087500	0	0.00
115	14.95	465.087490	-10	-0.02
80	10.4	465.087490	-10	-0.02

PERFORMED BY:

  
 Doug Noble, B.A.S. E.E.T.

PAGE NO. 53 of 53.  
NAME OF TEST: Necessary Bandwidth and Emission Bandwidth  
SPECIFICATION: 47 CFR 2.202(g)

MODULATION = 19.2 K BPS

NECESSARY BANDWIDTH CALCULATION:

MAXIMUM MODULATION (M), kHz = 19.2K/2  
MAXIMUM DEVIATION (D), kHz = 3.0  
CONSTANT FACTOR (K) = 1.0  
NECESSARY BANDWIDTH (B<sub>N</sub>), kHz = (2xM) + (2xDxK)  
= 25K2F1D

MODULATION = 9.6 K BPS

NECESSARY BANDWIDTH CALCULATION:

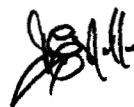
MAXIMUM MODULATION (M), kHz = 9.6/2  
MAXIMUM DEVIATION (D), kHz = 1.5  
CONSTANT FACTOR (K) = 1.0  
NECESSARY BANDWIDTH (B<sub>N</sub>), kHz = (2xM) + (2xDxK)  
= 12K6F1D

MODULATION = 1.2 K BPS

NECESSARY BANDWIDTH CALCULATION:

MAXIMUM MODULATION (M), kHz = 1.2/2  
MAXIMUM DEVIATION (D), kHz = 1.5  
CONSTANT FACTOR (K) = 1.0  
NECESSARY BANDWIDTH (B<sub>N</sub>), kHz = (2xM) + (2xDxK)  
= 4K2F1D

PERFORMED BY:

  
Doug Noble, B.A.S. E.E.T.

END OF TEST REPORT

TESTIMONIAL  
AND  
STATEMENT OF CERTIFICATION

THIS IS TO CERTIFY THAT:

1. THAT the application was prepared either by, or under the direct supervision of, the undersigned.
2. THAT the technical data supplied with the application was taken under my direction and supervision.
3. THAT the data was obtained on representative units, randomly selected.
4. THAT, to the best of my knowledge and belief, the facts set forth in the application and accompanying technical data are true and correct.

CERTIFYING ENGINEER:



Morton Flom, P. Eng.